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REPORT

OF THE

VIZAGAPATAM AND BACKERGUNGE CYCLONES

OF

October 1876.

BY

J. ELLIOTT, Esq., M.A.,

Meteorological Reporter to the Government of Bengal.

Calcutta:
PRINTED AT THE BENGAL SECRETARIAT PRESS.
1877.

REPORT

OF THE

VIZAGAPATAM AND BACKERGUNGE CYCLONES

OF

OCTOBER 1876.

The following report deals with the cyclones which marked the transition from the south-west to the north-east monsoon during the month of October 1876. The first originated to the west of the Andamans, in latitude 14°30′N. and longitude 90°E., on the evening of the 5th, and advanced across the Bay in a west-north-westerly direction, and reached the coast about twelve miles north of Vizagapatam, from which it passed slowly northwards, gradually breaking up to the north of Cuttack, in the Chota Nagpore district, but influencing and modifying the meteorology of Bengal and Upper India for some days after the dissolution of the vortex. The second cyclone vortex was generated to the west of the Andamans, in latitude 13°30′N. and longitude 89°E., on the afternoon of the 29th, and advanced first almost due north, but was gradually deflected to the north-east, and struck the coast at the estuary of the Megna at 3 A.M. on the morning of the 1st, and was broken up a few hours afterwards by the disintegrating action of the Tipperah Hills. It influenced the weather in Eastern Bengal and Assam to a slight extent until the 3rd, when the north-east monsoon was finally fully established over Northern India and the head of the Bay.

The report, after a brief introductory chapter sketching the various theories which have been proposed to explain the formation and motion of cyclones, is arranged under the following heads:—

(1.) SECTION I—Gives the results of the observations for the month of October taken at the observatories in Bengal, Behar, and Orissa, and a few stations in the North-Western Provinces and Southern India. They are accurate and trustworthy, and it is from these mainly I have deduced the conclusions to which I have arrived, and from which they will admit of verification.

(2.) SECTION II—Deals with the Vizagapatam cyclone under the following chapters:—

Chapter I gives the logs of six vessels involved in the cyclone, and special observations and information from Vizagapatam and its neighbourhood.

Chapter II gives the meteorology of the Bay and Northern India before and during the cyclone, and traces out, from the information of the preceding section and chapter, the formation and line of advance of the cyclone vortex.

Chapter III gives a very brief summary of the cyclone, and discusses the causes and phenomena of the cyclone.

(3.) SECTION III—Deals with the Backergunge cyclone, and is arranged under the following chapters:—

Chapter I gives *in extenso* the logs of 23 vessels involved in the cyclone.

Chapter II gives the meteorology of the Bay and of Northern India prior to the formation of the cyclone, or from the 20th to the 30th October.

Chapter III deals with the line of advance of the cyclone from its place of formation to the mouth of the Megna.

Chapter IV investigates the path of the cyclone in Eastern Bengal until its disappearance under the action of the Tipperah Hills.

Chapter V gives a brief account of the storm-waves which swept over the islands at the entrance to the Megna, and flooded the Chittagong, Noakholly, and Backergunge coasts.

Chapter VI discusses the causes and phenomena of the Backergunge cyclone.

INTRODUCTORY CHAPTER.

CYCLONE THEORIES.

A BRIEF recapitulation of the various theories which have been advanced to account for the phenomena and origin of cyclones will be useful, not merely for reference in the discussion of the recent cyclones, but also as showing the present practical and theoretical knowledge on the subject of cyclones. The observations hereafter given in detail will be employed partly to test the various theories.

The earliest writer of importance on the subject of cyclones was Mr. Redfield. Colonel Capper, in his observations on the wind and monsoons published in 1801, had stated his belief that the storms of the Indian Ocean were whirlwinds or rotatory storms. He stopped short at this anticipation, stating that " it would perhaps not be a matter of great difficulty to ascertain the position of a ship in a whirlwind by observing the strength and changes of the wind. If the changes are sudden and the wind violent, in all probability the ship must be near the vortex of the whirlwind; whereas if the wind blows a great length of time from the same point; and the changes are gradual, it may be reasonably supposed the ship is far from the vortex."

Mr. Redfield contributed a series of papers dating from the year 1822 to American scientific journals, in which he developed the theory that they were vast progressive whirlwinds or rotating storms moving along curved paths. About the same time Professor Dove in Europe had come to the conclusion that all the phenomena of such storms are fully explicable by the assumption of one or more rotary atmospheric currents or whirlwinds advancing slowly in a definite direction.

The circular theory was also adopted by the next important writer on this subject, Lieutenant-Colonel Reid, of the Royal Engineers, in his work on the Laws of Storms. He not merely confirmed the results of the investigations of Mr. Redfield, but laid down, from examination of the tracks of a number of storms, the important generalization that in the rotary storms of the tropical regions of the northern hemisphere, the direction of rotation of the winds is N. W. S. E., or opposite to the direction of motion of the hands of a watch with its face upwards; whereas in the storms of the tropical regions of the southern hemisphere, the direction of rotation is the opposite—N. E. S. W. He was thus enabled to give a series of rules for the guidance of sailors navigating tropical seas.

Mr. Piddington took up a similar line of inquiry, and analyzed carefully the path of every storm in the Bay of Bengal and Indian Ocean of which he could obtain any records. He fully adopted the circular rotatory theory, and suggested the use of the word cyclone for all such storms. He gave an elaborate series of rules for the information and guidance of sailors navigating these seas.

But, as Mr. Buchan observes in his hand-book on meteorology, it should always be remembered that in the charts given by Reid, Piddington, and others who adopt in its simplicity the circular theory, the arrows representing the wind direction are drawn always tangential to circles described about the centre of the area of calm solely on the assumption of the truth of the circular theory. They are hypothetical directions serving in their works a definite purpose, that of enabling them to lay down practical rules for sailors navigating seas visited by cyclones, and are undoubtedly a rough approximation to the actual character of the atmospheric motion during cyclones, which is what Sir John Herschel terms vorticose or spiral in its nature. Numerous synchronous storm charts, giving the absolute direction of the winds at the same instant, have been drawn by various meteorologists, and show that there is an indraught of air to the central region of calm as well as a rotatory motion. The combination of the two motions gives a spiral or incurving motion of the air towards the centre.

The upholders of the circular theory had thus seized only a part of the truth. The other element, the indraught or centripetal part of the motion, an important element, was left out of consideration. Mr. Espy, of Philadelphia, adopted this element to the exclusion of the other, laying down what is known as the centripetal theory. From personal observation of the direction in which the trees were lying on the ground after the tornado of the 19th of June in New Brunswick, he came to the conclusion that in this storm the winds must all have been blowing and converging to a centre. He afterwards adopted the theory of the converging motion of the air in the case of all cyclones to a centre caused by a rapid upward vertical motion at this centre, due to the vast amount of heat given out by the condensation of vapour and the subsequent fall of rain. He also laid down as a general rule that whenever a fall of rain is going on over a large area, there is necessarily produced an upward motion of the strata in and above which condensation is going on, which is followed by an indraught from all directions in the lower atmospheric strata and an outdraught in the higher.

Dr. Dove meanwhile was devoting great attention to the subject of the meteorology of winds and storms. He elaborated the idea which underlay the explanation given by Hadley to account for the easting of the trades wind, and established what he termed the law of gyration. This is that, in consequence of the diminishing velocity of rotation at places of the earth's surface as we proceed from the Equator to the Poles, "in the Northern Hemisphere, when polar and equatorial winds succeed each other, the winds veer in the direction S. W. N. E. S., and in the Southern Hemisphere, when polar and equatorial currents succeed each other, in the direction of S. E. N. to S. He also explained on theoretical principles the opposite directions of rotation of cyclones in the Northern and Southern Hemispheres. He also showed that the cyclonic movement of the wind was in all cases in accordance with the general principle underlying the law of gyration, and that it might be due to a mechanical obstruction, as a range of hills, or the resistance of another mass of air, or that it might result from the struggle of opposite currents which alternately displaced each other. The former is apparently his more matured explanation. The next theory of importance, that of Professor Taylor, adopted by Sir John Herschel in his work on Meteorology, is a modification of Espy's Centripetal Theory and Dove's Law of Gyration. Cyclones owe their origin, according to this theory, to the action of local heat producing an upward expansion and vertical motion of the air over a limited area. This is followed by an indraught from all the neighbouring districts, which would be strictly in accordance with the centripetal theory, if the earth had no motion of rotation. The rotation causes these winds to be deflected in approaching the centre, and the result is an inner spiral motion round a centre, over which a continuous ascensional movement of the air is going on.

The latest authorities on the subject of cyclones in the Indian Ocean and Bay of Bengal are Messrs. Meldrum, Blanford, and Willson. Mr. Meldrum, who has made a lengthened study of the cyclones of the Indian Ocean, and has traced out a connection between solar spot frequency and cyclone prevalence frequency, maintains that in the Southern Indian Ocean they are primarily due to the action of lateral parallel opposite currents of winds. In the intermediate belt between the opposite winds the mass of air is in a state of comparative calm, and in consequence of the friction on opposite sides, it gradually acquires a rotatory motion. In this theory the rotatory motion and the barometric depression at and near the centre primarily result from the action of the parallel and opposite winds. Mr. Willson maintained the same theory. His opinion, as given briefly in the report on the Meteorology of Bengal for 1874, is as follows:—"I have elsewhere stated that in the cases which I had been enabled to examine it appeared highly probable that cyclones in the Bay of Bengal, like those in the Southern Indian Ocean, were generated between parallel wind currents blowing in opposite directions, and that the determining causes were probably not local, but far removed from the place of the storm's origin; that in fact the unusual vigour of the opposing winds which precedes the generation of such storms is probably produced in the first instance by abnormally high pressure some 10 or 15 days beforehand on both sides of, but far removed from, the belt which afterwards becomes the battle ground of the opposite currents. In the case of the cyclone under report (the cyclone of 3rd to 5th May 1874) no doubt whatever can be entertained of the previous existence of the opposite winds, and it is equally certain that about eight days beforehand the pressures to the eastward, and to the westward especially, were very much above the average for the season.

The full explanation of his views and their extension to the October cyclones of the Bay of Bengal is given by Mr. Willson in his report on the Midnapore cyclone. The following extract will suffice to show its nature:—

"It appears to me that the theory of opposite currents, perhaps slightly modified in accordance with local circumstances, would account for the formation of this cyclone, as well as the local depression theory. The winds were N E over all the Bay north of latitude 17°, and W S W south of latitude 15°. It seems therefore not improbable that long before the N E surface wind commences to blow with any strength, there is an upper N E current from the region of high pressure to the region of relatively low pressure. This current is drier, colder, and heavier than the opposing damp W S W current, which must therefore be forced upwards along the belt where the winds collide and where the N E current descends. The W S W current appears to be always the more powerful of the two. This fact is explained in the present instance by the high pressure at Nancowry compared with the pressure over Bengal. However, it would seem probable that a very gentle N E current, or even a calm dense atmosphere would be sufficient to check and force upwards the powerful but less dense W S W monsoon, thereby producing the enormous precipitation of moisture which is always observed near the place of the origin of a cyclone, and which probably plays a very important part in its formation. As the precipitation of moisture continues, the atmospheric pressure diminishes along the head of the W S W monsoon. The north-easterly current hence becomes more vigorous, and gradually extends northwards as a strong surface-wind. Ultimately the N E current becomes sufficiently powerful to generate the cyclone. The above is a short sketch of how it appears to me the theory of opposite currents may be applied to account for the formation of the cyclones of the Bay of Bengal."

Mr. Blanford's theory is given briefly in an appendix to his paper on "The Winds of Northern India." It is what has been termed the local depression theory. A calm state of the atmosphere, or one in which the winds are light and variable over the open sea, is the first condition favourable to the production of cyclones. The second condition is a high or moderately high temperature. The consequence of this combination of conditions will be the production and ascent of a large quantity of vapour, which will be condensed with the liberation of its latent heat over the area of its production, instead of its being carried away to some distant origin. If this state of things last for some days, the atmospheric pressure will be locally lowered, causing, or tending to cause, an indraught of air towards the place of minimum pressure. One further condition appears to be essential. The actual formation is finally determined by the inrush of a saturated stormy current from the S. W. or W. S. W.

SECTION I.

SUMMARY OF METEOROLOGICAL OBSERVATIONS TAKEN IN BENGAL, ASSAM, BEHAR, AND ORISSA DURING THE MONTH OF OCTOBER 1876.

DESCRIPTION OF TABLES.—The following tables give the results of the meteorological observations recorded during the month of October at the Government Observatories in Bengal, Assam, Behar, Orissa, the North-West Provinces, and a few stations in the south of India beyond these limits, amongst which the most important are those of Port Blair and Nancowry, in the Andamans and Nicobars, and Madras and Vizagapatam, on the Coromandal Coast. They illustrate the variations of the more important meteorological elements during the month, and are the chief basis for the scientific discussion of the meteorology of the two cyclone periods of the month. A few more detailed observations taken at short intervals will be found embodied in the general account of each cyclone.

TABLE I—Gives the readings of the barometer at 26 stations as recorded at 10 and 16 hours each day reduced to the temperature 32°F.

TABLE II—Gives the mean atmospheric pressure of each day during the month, corrected for temperature and reduced to sea level. The mean for the day is obtained, in the case of Vizagapatam, Saugor Island, Calcutta, Allahabad, and False Point, by taking the arithmetical mean of the readings at 4 hours, 10 hours, 16 hours, and 22 hours, reduced as above stated. The means for Madras and Trichinopoly are deduced from three readings daily, viz. at 10 hours, 16 hours, and 22 hours. The means for the remaining stations are obtained from two readings only, viz. 10 hours and 16 hours. In the case of all, except the stations where four readings of the barometer are made, the mean of the day given in the table is deduced from the arithmetic means by the addition of a small correction, calculated by means of certain factors which have been obtained from an examination of four-hourly or hourly observations at certain typical stations. All the barometric data are corrected to the Calcutta standard, which is believed to read ·011 higher than the Kew standard.

TABLE III.—This table gives for each day of the month the maximum and minimum temperature of the day and the mean temperature. The latter is for all the Bengal stations deduced from the arithmetic mean of the minimum temperature and the temperature at 10 hours and 16 hours by means of factors obtained in exactly the same manner as the factors employed to give the mean daily barometric height. In the case of the five stations (Vizagapatam, False Point, Saugor Island, Calcutta, and Allahabad) where six-hourly observations are taken, the mean of the four temperatures thus obtained is given as the mean temperature of the day.

TABLE IV—Gives the recorded wind direction at the two hours of observation—10 hours and 16 hours—for each day of the month.

TABLE V—Gives the actual amount of wind as recorded by a Robinson's anemometer during the preceding twenty-four hours, from 16 hours of the previous day to 16 hours of the day for which the wind velocity is given in the table.

TABLE VI—Gives the humidity of the air at the hours of observation on each day during the month. The humidities are calculated from readings of the dry and wet bulb thermometers by August's formula modified by Regnault, saturation being represented by 100.

TABLE VII—Gives the rainfall for each day of the month at the 177 stations in Bengal and Assam which record rainfall. The quantity is measured at 18 hours, and thus represents the rain-fall during the twenty-four hours preceding this hour daily.

TABLE I.

Daily Barometric readings at 10 *hours and* 16 *hours reduced for temperature—October* 1876.

Stations.	1		2		3		4		5	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	29·853	29·780	29·836	29·768	29·860	29·744	29·768	29·659	29·797	29·720
Nancowry	·889	·795	·884	·781	·908	·784	·839	·756	·864	·810
Trichinopoly	·615	·482	·643	·510	·685	·527	·648	·499	·635	·493
Madras	·858	·749	·891	·765	·903	·778	·888	·771	·881	·761
Vizagapatam	·818	·715	·858	·738	·915	·823	·885	·774	·846	·758
Akyab	·890	·786	·893	·820	·907	·781	·872	·782	·881	·814
False Point	·819	·710	·849	·769	·899	·799	·909	·799	·879	·799
Cuttack	·738	·632	·796	·696	·850	·738	·847	·717	·832	·730
Saugor Island	·839	·709	·861	·767	·911	·824	·908	·781	·890	·797
Chittagong	·800	·677	·832	·714	·852	·723	·829	·701	·830	·716
Calcutta	·779	·686	·849	·759	·911	·821	·904	·787	·912	·797
Burdwan	·696	·610	·790	·682	·839	·740	·831	·704	·827	·733
Jessore	·756	·672	·824	·750	·872	·791	·888	·857	·876	·780
Dacca	·794	·707	·838	·766	·889	·774	·874	·756	·870	·771
Silchar	·809	·691	·821	·718	·866	·721	·822	·676	·838	·712
Hazaribagh	27·797	27·752	27·882	27·807	27·944	27·843	27·925	27·831	27·924	27·842
Berhampore	29·727	29·642	29·815	29·704	29·877	29·761	29·860	29·731	29·860	29·760
Gya	·509	·397	·544	·454	·599	·476	·578	·472	·569	·474
Patna	·641	·569	·712	·619	·774	·649	·737	·626	·739	·651
Purneah	·694	·612	·765	·650	·828	·694	·800	·657	·802	·697
Sibsagar	·522	·425	·594	·482	·637	·495	·599	·464	·611	·484
Goalpara	·492	·352	·507	·392	·558	·418	·518	·387	·492	·424
Allahabad	·548	·463	·593	·496	·646	·540	·634	·511	·606	·524
Lucknow	·473	·398	·521	·429	·570	·381	·568	·450	·534	·447
Agra	·270	·184	·365	·266	·395	·302	·387	·275	·346	·255
Roorkee	28·927	28·848	28·983	28·894	·040	28·953	·022	28·913	·010	28·911

Stations.	6		7		8		9		10	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h
Port Blair	29·855	29·753	29·850	29·763	29·801	29·726	29·821	29·740	29·895	29·804
Nancowry	·934	·804	·916	·771	·840	·806	·863	·806	·921	·833
Trichinopoly	·627	·482	·602	·463	·559	·418	·547	·428	·607	·495
Madras	·867	·738	·794	·665	·744	·618	·752	·645	·827	·735
Vizagapatam	·807	·650	·527	·315	·283	·379	·585	·523	·756	·690
Akyab	·906	·795	·892	·771	·808	·719	·804	·705	·906	·806
False Point	·845	·756	·784	·655	·687	·616	·588	·519	·738	·701
Cuttack	·842	·710	·708	·571	·593	·508	·469	·420	·677	·614
Saugor Island	·915	·808	·830	·725	·731	·648	·684	·576	·734	·690
Chittagong	·834	·724	·816	·681	·759	·628	·715	·601	·792	·707
Calcutta	·910	·830	·866	·743	·760	·666	·705	·598	·730	·691
Burdwan	·843	·731	·803	·672	·696	·594	·630	·518	·633	·592
Jessore	·894	·790	·844	·747	·757	·616	·712	·612	·728	·669
Dacca	·887	·782	·852	·840	·784	·674	·748	·641	·772	·720
Silchar	·841	·755	·819	·680	·768	·664	·720	·605	·829	·745
Hazaribagh	27·932	27·835	27·866	27·770	27·764	27·692	27·688	27·568	27·636	27·672
Berhampore	29·874	29·772	29·828	29·705	29·754	29·724	29·702	29·587	29·681	29·619
Gya	·577	·475	·526	·423	·446	·366	·452	·339	·399	·306
Patna	·744	·664	·725	·595	·651	·570	·578	·472	·522	·469
Purneah	·824	·698	·795	·662	·739	·654	·679	·569	·614	·587
Sibsagar	·618	·486	·589	·453	·572	·507	·570	·438	·548	·506
Goalpara	·552	·426	·518	·383	·491	·417	·461	·333	·472	·430
Allahabad	·608	·526	·573	·460	·508	·422	·464	·391	·499	·415
Lucknow	·556	·473	·528	·409	·430	·340	·451	·377	·448	·360
Agra	·370	·298	·335	·228	·242	·123	·224	·129	·276	·170
Roorkee	·036	28·930	·008	28·900	28·901	28·793	28·890	28·778	28·934	28·832

TABLE I—(*Continued*).

STATIONS.	11		12		13		14		15	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	29·927	29·823	29·947	29·834	29·959	29·842	29·943	29·929	29·956	29·843
Nancowry	·940	·807	·940	·823	·944	·841	·944	·806	·943	·835
Trichinopoly	·687	·544	·700	·561	·715	·576	·730	·571	·738	·601
Madras	·929	·805	·965	·850	·964	·833	·972	·869	·992	·896
Vizagapatam	·910	·809	·961	·846	·967	·846	·994	·869	30·013	·890
Akyab	·998	·878	30·006	887	30·000	·904	·994	·901	·010	·923
False Point	·909	·817	29·967	·864	29·968	·774	·977	·900	29·994	·925
Cuttack	·834	·750	·899	·779	·902	·792	·917	·805	·935	·835
Saugor Island	·927	·831	·962	·859	·968	·857	·969	·879	30·005	·925
Chittagong	·915	·795	·914	·818	·924	·806	·915	·804	29·938	·856
Calcutta	·929	·836	·959	·853	·957	·845	·970	·869	·998	·909
Burdwan	·855	·756	·890	·790	·875	·753	·885	·779	·904	·823
Jessore	·914	·842	·917	·819	·914	·827	·915	·774	·924	·864
Dacca	·927	·831	·966	·850	·948	·830	·931	·825	·982	·905
Silchar	·923	·834	·940	·855	·942	·817	·922	·823	·960	·862
Hazaribagh	27·903	27·827	27·943	27·844	27·932	27·863	27·951	27·878	27·969	27·896
Berhampore	29·887	29·788	29·992	29·825	29·907	29·785	29·908	29·790	30·005	29·852
Gya	·560	·483	·588	·490	·583	·490	·597	·506	29·610	·543
Patna	·755	·669	·794	·678	·757	·681	·794	·689	·802	·725
Purneah	·840	·761	·896	·764	·845	·701	·841	·740	·847	·803
Sibsagar	·705	·608	·715	·599	·690	·557	·659	·528	·688	·599
Goalpara	·613	·512	·629	·503	·609	·480	·569	·439	·602	·505
Allahabad	·590	·517	·660	·570	·674	·575	·635	·509	·663	·592
Lucknow	·518	·441	·512	·513	·597	·495	·560	·415	·556	·546
Agra	·300	·225	·381	·278	·313	·268	·327	·251	·420	·324
Roorkee	28·970	28·892	·057	28·943	·098	28·964	·063	28·971	·086	·019

STATIONS.	16		17		18		19		20	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	29·956	29·854	29·972	29·872	29·948	29·845	29·941	29·815	29·958	29·823
Nancowry	·942	·846	·955	·862	·943	·861	·940	·826	·942	·804
Trichinopoly	·736	·614	·772	·636	·762	·606	·755	·622	·740	·613
Madras	·995	·913	30·034	·912	30·025	·904	30·014	·907	·990	·897
Vizagapatam	30·019	·911	·049	·941	·042	·940	·062	·950	30·004	·921
Akyab	·016	·925	·028	·920	·013	·916	·015	·901	29·996	·881
False Point	·037	·938	·051	·954	·061	·951	·052	·937	30·021	·927
Cuttack	29·972	·850	29·994	·875	29·986	·875	29·974	·851	29·969	·843
Saugor Island	30·039	·931	30·061	·955	30·057	·949	30·042	·917	30·030	·916
Chittagong	29·970	·856	29·977	·864	29·967	·856	29·966	·850	29·990	·829
Calcutta	30·039	·924	30·060	·935	30·050	·931	30·028	·910	30·033	·917
Burdwan	29·947	·829	29·969	·861	29·979	·860	29·896	·826	29·900	·831
Jessore	30·002	·911	30·026	·919	30·044	·910	30·006	·893	30·014	·892
Dacca	·014	·902	·029	·924	·028	·924	·011	·901	29·993	·886
Silchar	29·986	·875	·017	·881	·001	·866	29·979	·858	·968	·833
Hazaribagh	28·002	27·913	28·015	27·939	28·042	27·937	28·021	27·932	28·014	27·925
Berhampore	29·980	29·848	29·998	29·910	29·972	29·888	29·978	29·864	29·987	29·938
Gya	·678	·584	·684	·585	·696	·604	·690	·592	·682	·586
Patna	·853	·736	·860	·763	·893	·763	·872	·766	·873	·759
Purneah	·820	·795	·873	·803	·930	·792	·845	·841	·873	·785
Sibsagar	·737	·621	·800	·682	·778	·633	·746	·611	·715	·596
Goalpara	·652	·522	·695	·565	·699	·547	·660	·528	·642	·502
Allahabad	·715	·603	·702	·570	·738	·609	·759	·654	·758	·649
Lucknow	·661	·555	·649	·488	·691	·590	·696	·600	·687	·581
Agra	·446	·332	·417	·360	·502	·411	·512	·413	·488	·381
Roorkee	·126	·019	·119	·052	·183	·096	·159	·071	·120	·034

TABLE I—(*Concluded*).

STATIONS.	21		22		23		24		25	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	29·907	29·797	29·892	29·767	29·864	29·759	29·897	29·788	29·881	29·788
Nancowry	·886	·786	·882	·761	·842	·755	·857	·744	·858	·754
Trichinopoly	·719	·582	·736	·597	·739	·589	·718	·585	·716	·589
Madras	·996	·893	·989	·902	·981	·874	·979	·881	·982	·880
Vizagapatam	·999	·902	30·000	·894	·996	·887	·981	·901	·998	·901
Akyab	·958	·885	29·972	·884	·968	·866	·974	·880	·974	·879
False Point	30·027	·927	30·042	·939	30·017	·927	30·022	·935	30·002	·939
Cuttack	29·947	·849	29·962	·863	29·959	·847	29·969	·867	29·955	·867
Saugor Island	30·021	·927	30·030	·921	30·024	·915	30·039	·925	·997	·917
Chittagong	29·922	·809	29·928	·822	29·928	·805	29·919	·820	·901	·804
Calcutta	30·030	·931	30·027	·925	30·032	·907	30·031	·924	30·012	·908
Burdwan	29·905	·854	29·902	·842	29·959	·840	29·957	·840	29·943	·832
Jessore	30·001	·917	·999	·917	30·007	·904	30·005	·901	30·026	·917
Dacca	29·994	·885	·985	·880	29·989	·880	29·995	·888	29·974	·871
Silchar	·959	·829	·950	·818	·958	·826	·961	·828	·948	·810
Hazaribagh	28·014	27·936	28·018	27·933	28·016	27·928	28·033	27·945	28·011	27·932
Berhampore	29·987	29·872	29·975	29·861	29·986	29·860	29·983	29·918	29·973	29·900
Gya	·688	·592	·699	·590	·694	·588	·702	·608	·599	·425
Patna	·885	·767	·871	·762	·882	·770	·908	·785	·877	·770
Purneah	·878	·802	·924	·811	·942	·806	·944	·818	·910	·810
Sibsagar	·747	·596	·724	·589	·740	·594	·759	·615	·760	·610
Goalpara	·658	·533	·656	·522	·667	·526	·668	·533	·658	·538
Allahabad	·737	·658	·753	·648	·748	·650	·764	·666	·750	·638
Lucknow	·677	·592	·687	·587	·681	·583	·704	·602	·685	·570
Agra	·476	·388	·487	·377	·465	·363	·476	·396	·482	·368
Roorkee	·114	·041	·141	·033	·133	·033	·156	·090	·150	·042

STATIONS.	26		27		28		29		30		31	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	29·863	29·776	29·809	29·732	29·792	29·706	29·807	29·722	29·793	29·722	29·827	29·751
Nancowry	·862	·767	·821	·735	·808	·748	·828	·759	·839	·754	·855	·760
Trichinopoly	·720	·595	·675	·570	·666	·545	·664	·500	·609	·450	·596	·473
Madras	·972	·848	·931	·822	·899	·800	·920	·759	·845	·713	·845	·738
Vizagapatam	30·029	·907	·962	·843	·951	·824	·877	·778	·784	·656	·765	·647
Akyab	29·962	·867	·938	·838	·892	·817	·932	·872	·924	·782	·794	·616
False Point	30·022	·909	·988	·887	·942	·869	·933	·849	·865	·745	·627	·495
Cuttack	29 949	·847	·923	·807	·879	·794	·870	·770	·826	·696	·615	·538
Saugor Island	30·011	·897	·987	·871	·942	·853	·948	·843	·918	·781	·721	·521
Chittagong	29·920	·788	·897	·754	·860	·752	·864	·758	·884	·747	·707	·570
Calcutta	30·014	·882	·967	·861	·952	·854	·963	·834	·914	·806	·781	·624
Burdwan	29·927	·812	·913	·784	·869	·763	·881	·787	·849	·744	·740	·602
Jessore	30·016	·847	·967	·859	·939	·834	·939	·835	·912	·804	·793	·673
Dacca	29·980	·860	·954	·828	·922	·819	·922	·819	·909	·807	·809	·704
Silchar	·940	·796	·915	·770	·886	·768	·900	·772	·905	·763	·799	·695
Hazaribagh	28·009	27·914	27·980	27·878	27·953	27·874	27·975	27·886	27·942	27·834	27·856	27·744
Berhampore	30·014	29·851	29·984	29·808	29·889	29·798	29·914	29·798	29·893	29·773	29·803	29·681
Gya	29·598	·491	·528	·399	·539	·442	·521	·403	·536	·448	·590	·483
Patna	·864	·748	·838	·709	·812	·722	·849	·728	·822	·684	·745	·593
Purneah	·903	·788	·878	·751	·862	·761	·889	·776	·873	·764	·778	·628
Sibsagar	·746	·580	·712	·556	·701	·560	·718	·586	·711	·560	·627	·532
Goalpara	·642	·494	·614	·472	·600	·495	·627	·493	·618	·457	·526	·390
Allahabad	·742	·627	·702	·580	·680	·582	·717	·607	·694	·568	·632	·492
Lucknow	·673	·564	·636	·519	·616	·529	·669	·554	·641	·516	·574	·451
Agra	·486	·362	·452	·334	·433	·330	·468	·364	·444	·324	·397	·271
Roorkee	·148	·036	·105	28·994	·096	28·997	·156	·023	·106	28·995	·082	28·935

TABLE II.

Barometric means reduced to sea level—October 1876.

STATIONS.	1	2	3	4	5	6	7	8
Port Blair	29·880	29·865	29·865	29·776	29·821	29·867	29·870	29·827
Nancowry	·923	·914	·927	·878	·918	·950	·924	·904
Trichinopoly	·834	·869	·876	·865	·857	·831	·803	·772
Madras	·840	·865	·871	·863	·851	·815	·746	·708
Vizagapatam	·804	·836	·881	·861	·836	·750	·410	·296
Akyab	·863	·880	·870	·852	·871	·875	·858	·788
False Point	·782	·827	·885	·873	·866	·818	·731	·669
Cuttack	·766	·827	·875	·863	·862	·858	·722	·632
Saugor Island	·781	·819	·865	·851	·853	·853	·778	·701
Chittagong	·832	·867	·881	·859	·867	·872	·842	·786
Calcutta	·770	·822	·871	·869	·876	·877	·829	·745
Burdwan	·751	·835	·888	·864	·878	·886	·836	·744
Jessore	·733	·807	·850	·898	·847	·861	·816	·704
Dacca	·787	·838	·867	·851	·857	·870	·882	·765
Silchar	·839	·862	·888	·843	·868	·891	·844	·809
Hazaribagh	·820	·881	·923	·904	·915	·911	·853	·769
Berhampore	·747	·823	·883	·858	·874	·887	·830	·804
Gya	·807	·847	·886	·872	·869	·875	·826	·760
Patna	·786	·845	·889	·860	·874	·885	·839	·794
Purneah	·780	·835	·886	·852	·874	·886	·855	·823
Sibsagar	·813	·879	·906	·871	·888	·891	·862	·883
Goalpara	·823	·846	·881	·844	·849	·882	·848	·856
Allahabad	·815	·849	·888	·880	·877	·876	·822	·778
Lucknow	·808	·847	·848	·882	·865	·888	·843	·759
Agra	·791	·884	·917	·897	·868	·901	·850	·750
Roorkee	·787	·840	·901	·873	?	·889	·859	·750

STATIONS.	9	10	11	12	13	14	15	16
Port Blair	29·843	29·912	29·938	29·954	29·964	29·999	29·962	29·968
Nancowry	·916	·958	·955	·962	·974	·956	·970	·975
Trichinopoly	·790	·838	·890	·921	·927	·933	·958	·960
Madras	·745	·828	·891	·934	·929	·954	·971	·980
Vizagapatam	·596	·755	·890	·923	·939	·960	·973	·990
Akyab	·779	·881	·964	·972	·977	·972	·991	·995
False Point	·597	·733	·881	·932	·918	·958	·984	30·013
Cuttack	·526	·728	·874	·922	·930	·944	·968	29·994
Saugor Island	·643	·721	·873	·916	·916	·929	·962	·986
Chittagong	·751	·843	·959	·960	·959	·954	·991	30·007
Calcutta	·684	·721	·885	·925	·920	·932	·961	29·994
Burdwan	·672	·713	·905	·940	·914	·932	·964	·984
Jessore	·681	·718	·898	·887	·889	·862	·914	·972
Dacca	·731	·782	·915	·944	·925	·914	·979	·994
Silchar	·756	·880	·972	·991	·975	·968	30·006	30·025
Hazaribagh	·659	·696	·911	·935	·939	·954	29·979	·002
Berhampore	·707	·714	·901	·971	·910	·913	·991	29·973
Gya	·749	?	?	?	·886	·903	·934	·987
Patna	·706	·680	·895	·917	·902	·922	·947	·977
Purneah	·741	·730	·929	·957	·900	·918	·953	·936
Sibsagar	·847	·869	30·000	30·004	·969	·936	·990	30·024
Goalpara	·795	·848	29·968	29·969	·947	·902	·951	29·986
Allahabad	·745	·780	·868	·924	·928	·889	·945	·973
Lucknow	·792	·781	·854	·889	·922	·861	·932	·989
Agra	·742	·791	·829	·897	·858	·859	·950	·964
Roorkee	·735	·787	·832	·905	·949	·945	·977	·992

TABLE II—(*Concluded*).

STATIONS.	17	18	19	20	21	22	23	24
Port Blair	29·985	29·960	29·941	29·953	29·915	29·892	29·875	29·906
Nancowry	·990	·983	·964	·954	·917	·902	·880	·881
Trichinopoly	·992	·967	·972	·959	·939	·959	·948	·935
Madras	30·001	·991	·986	·965	·975	·975	·950	·957
Vizagapatam	·010	30·010	30·024	·998	·974	·974	·974	·970
Akyab	29·999	29·989	29·983	·983	·945	·953	·942	·952
False Point	30·023	30·024	30·016	30·000	·998	30·006	·999	30·007
Cuttack	·018	·013	29·996	29·989	·981	29·996	·986	·001
Saugor Island	·004	29·999	·988	·975	·976	·978	·972	29·984
Chittagong	·015	30·005	30·002	30·004	·960	·970	·962	·964
Calcutta	·011	29·998	29·983	29·989	·994	·986	·985	·989
Burdwan	·012	30·016	·959	·965	·980	·972	·997	·995
Jessore	29·988	29·991	·964	·968	·976	·975	·971	·974
Dacca	30·012	30·012	·992	·976	·976	·968	·971	·977
Silchar	·045	·029	30·014	·997	·990	·980	·988	·990
Hazaribagh	·013	·039	·023	30·021	30·032	30·037	30·037	30·051
Berhampore	·016	29·992	29·981	·026	29·989	29·978	29·983	·013
Gya	29·990	30·005	·993	29·987	·994	30·000	·997	·011
Patna	·993	·009	30·001	·999	30·009	·000	30·008	·028
Purneah	·966	29·988	29·973	·957	29·968	29·996	·002	·009
Sibsagar	30·089	30·054	30·025	30·002	30·020	30·003	·013	·033
Goalpara	·030	·025	29·994	29 972	29·997	29·991	29·998	·003
Allahabad	29·961	29·986	30·013	30·009	30·003	30·011	30·010	·025
Lucknow	·948	30·023	·029	·014	·015	·018	·013	·034
Agra	·967	·039	·044	·014	·010	·007	29·987	·009
Roorkee	30·007	·061	·038	·001	29·999	·007	30·001	?

STATIONS.	25	26	27	28	29	30	31
Port Blair	29·897	29·883	29·833	29·812	29·828	29·820	29·852
Nancowry	·887	·896	·859	·859	·875	·877	·889
Trichinopoly	·933	·935	·898	·887	·859	·810	·820
Madras	·955	·926	·897	·875	·856	·797	·823
Vizagapatam	·975	·979	·930	·912	·849	·746	·740
Akyab	·951	·939	·913	·878	·926	·879	·732
False Point	30·008	·997	·969	·933	·916	·813	·617
Cuttack	29·994	·981	·948	·920	·903	·843	·658
Saugor Island	·970	·962	·934	·908	·908	·840	·619
Chittagong	·947	·948	·919	·900	·905	·911	·733
Calcutta	·981	·971	·939	·920	·921	·881	·722
Burdwan	·985	·967	·946	·913	·932	·894	·766
Jessore	·987	·944	·929	·902	·903	·874	·748
Dacca	·959	·956	·927	·906	·907	·894	·792
Silchar	·976	·964	·938	·922	·932	·931	·841
Hazaribagh	30·036	30·022	·983	·967	·984	·937	·840
Berhampore	29·998	29·992	·953	·904	·916	·893	·803
Gya	·859	·895	·812	·841	·811	·841	·886
Patna	30·005	·988	·956	·948	·971	·933	·847
Purneah	29·988	·974	·943	·939	·961	·947	·830
Sibsagar	30·033	30·011	·982	·978	·999	·983	·927
Goalpara	·001	29·969	·943	·948	·964	·940	·862
Allahabad	·010	·993	·949	·944	·975	·940	·878
Lucknow	·056	·997	·956	·952	·992	·959	·891
Agra	29·997	·995	·965	·955	·991	·962	·910
Roorkee	30·016	30·010	·968	?	30·015	·973	·928

TABLE III.

Daily Maximum, Minimum, and Mean Temperatures—October 1876.

STATIONS.	1			2			3			4		
	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.
Port Blair	86·0	76·0	75·4	86·0	77·1	75·9	84·5	79·3	76·4	78·4	75·8	74·9
Nancowry	77·1	76·2	74·3	80·1	78·1	75·3	79·1	77·2	74·3	80·1	77·6	74·3
Trichinopoly	95·8	84·2	75·1	95·3	82·6	72·1	96·7	84·8	74·2	96·4	84·7	76·1
Madras	91·4	82·9	75·8	97·4	84·3	76·8	96·0	84·1	74·8	92·1	82·9	76·8
Vizagapatam	86·5	83·5	81·0	86·3	83·8	80·0	87·0	84·3	81·6	86·5	84·5	82·7
Akyab	89·0	82·4	76·0	91·0	83·3	77·0	92·0	83·7	76·0	93·0	84·4	77·0
False Point	...	83·7	...	...	83·4	...	...	83·2	...	...	83·0	...
Cuttack	91·8	84·5	76·8	90·8	83·4	76·2	91·9	83·9	76·1	92·9	85·4	78·7
Saugor Island	87·9	83·8	77·4	86·2	81·7	77·4	86·2	80·6	77·8	88·6	83·2	77·3
Chittagong	88·9	82·6	75·8	85·2	79·1	75·8	90·0	82·4	73·8	90·0	83·8	76·3
Calcutta	87·7	82·7	79·3	88·0	82·8	80·0	85·7	82·1	80·7	88·5	83·3	79·4
Burdwan	89·5	83·1	77·4	88·5	81·9	77·4	89·5	84·0	79·4	91·5	84·6	78·4
Jessore	90·5	82·0	76·3	90·6	80·8	77·5	90·5	80·9	76·9	90·5	80·5	77·2
Dacca	88·8	81·6	77·7	88·3	79·0	78·5	89·1	81·5	76·3	88·1	83·5	77·9
Silchar	80·2	79·1	75·3	80·6	79·6	74·8	90·3	82·2	73·8	92·3	84·4	74·2
Hazaribagh	73·4	69·3	66·2	80·6	72·8	66·5	83·6	75·8	67·5	83·6	76·3	68·2
Berhampore	89·0	82·2	79·0	89·0	82·9	79·0	89·6	83·3	81·3	90·6	83·7	78·3
Gya	77·5	73·5	69·0	87·0	81·4	75·4	89·8	81·7	73·2	89·0	82·7	74·0
Patna	83·4	76·9	70·8	88·6	80·9	74·2	89·6	82·5	76·0	89·8	83·3	76·8
Purneah	84·1	74·6	69·3	89·2	80·7	74·9	89·7	82·7	75·9	90·7	83·9	75·4
Sibsagar	86·3	78·1	72·5	83·1	77·0	71·7	89·0	80·2	73·5	86·6	80·4	73·6
Goalpara	76·4	71·6	69·3	83·4	76·2	71·9	87·5	80·8	74·7	89·2	82·2	73·6
Allahabad	86·5	78·1	72·4	90·1	80·0	71·6	90·3	79·4	71·3	90·6	79·9	68·8
Lucknow	89·2	78·5	67·9	90·9	81·3	71·8	90·7	79·8	68·9	91·4	80·1	68·9
Agra	89·3	81·4	73·5	88·8	79·2	69·6	89·3	79·2	69·1	89·8	80·5	71·1
Roorkee	90·7	79·0	67·3	91·7	79·0	66·3	91·7	78·5	65·3	91·6	77·1	62·7

STATIONS.	5			6			7			8		
	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.
Port Blair	81·5	76·3	74·9	85·0	78·6	73·9	85·5	78·3	76·9	83·0	75·8	72·9
Nancowry	77·1	76·2	74·3	78·1	75·6	73·2	77·1	76·1	73·2	81·1	77·6	73·2
Trichinopoly	96·9	82·6	76·5	96·5	84·8	75·0	94·3	84·2	77·0	94·5	84·2	76·4
Madras	91·2	82·2	77·0	94·4	84·7	76·5	95·0	80·6	72·0	99·1	85·4	74·0
Vizagapatam	87·0	84·9	82·6	86·0	84·3	83·4	80·4	80·3	80·3	77·9	77·6	76·5
Akyab	90·0	82·4	75·0	91·5	83·8	77·0	91·0	83·1	75·0	91·0	84·1	78·0
False Point	...	82·9	...	...	79·2	...	...	81·9	...	...	82·2	...
Cuttack	91·5	84·5	77·3	79·7	76·3	75·1	84·8	78·2	74·5	86·7	79·8	74·8
Saugor Island	88·7	83·4	78·3	80·1	77·5	75·4	82·1	78·1	76·1	87·2	83·6	75·8
Chittagong	90·7	82·9	74·8	90·2	83·4	75·3	91·1	83·7	75·8	91·2	83·5	75·8
Calcutta	89·8	84·3	79·7	83·5	80·7	77·0	79·8	78·4	76·8	84·0	79·9	75·8
Burdwan	90·5	83·9	79·4	87·5	82·0	78·9	83·5	79·1	76·9	83·0	78·3	73·9
Jessore	90·0	82·4	76·0	88·5	82·9	77·4	85·0	80·5	77·4	86·5	79·5	76·0
Dacca	90·1	83·7	77·0	90·3	83·0	76·3	88·8	82·6	78·2	87·2	80·5	74·5
Silchar	91·3	84·9	75·3	78·3	79·2	75·5	87·6	81·4	72·5	85·3	80·7	74·2
Hazaribagh	82·8	74·6	66·0	82·6	75·9	67·8	75·6	72·6	70·2	73·6	69·4	67·2
Berhampore	89·6	82·7	77·3	89·6	83·1	78·3	87·6	83·6	77·3	81·6	78·0	77·3
Gya	89·4	81·2	71·4	88·8	79·8	69·2	83·1	77·2	74·2	75·5	72·9	69·4
Patna	90·0	81·7	72·2	89·2	80·2	72·2	83·6	79·2	73·0	75·8	74·0	73·0
Purneah	90·7	83·3	74·9	90·7	82·5	73·3	88·2	79·1	76·4	88·7	73·8	71·8
Sibsagar	89·5	80·6	73·6	89·7	81·2	73·3	87·2	78·6	74·7	76·4	73·1	71·4
Goalpara	88·3	81·9	74·0	89·2	81·3	73·7	83·4	78·1	75·4	70·7	69·5	69·6
Allahabad	90·3	78·4	68·4	90·8	77·9	67·5	88·8	77·9	69·1	80·8	74·3	69·5
Lucknow	91·2	78·1	65·0	91·7	78·8	66·0	87·9	77·2	66·5	89·7	78·7	67·0
Agra	88·3	79·0	69·6	88·3	79·5	70·6	88·3	79·2	70·1	87·8	78·2	68·6
Roorkee	90·0	?	?	92·0	76·6	61·2	90·7	76·9	63·2	90·2	75·9	61·7

TABLE III—(*Continued*).

STATIONS.	9			10			11			12		
	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.
Port Blair	82·5	78·5	76·9	85·5	79·3	74·9	87·0	80·8	76·4	86·5	80·3	75·9
Nancowry	81·1	77·6	73·2	82·1	78·1	73·2	83·1	78·6	73·2	85·1	81·1	77·3
Trichinopoly	96·3	84·7	74·1	98·9	84·9	75·1	99·9	85·2	75·4	96·3	83·9	74·0
Madras	98·7	85·3	76·4	97·4	84·8	76·8	91·4	83·6	77·6	92·4	83·5	80·5
Vizagapatam	84·5	82·2	78·5	85·0	82·3	79·0	85·0	82·1	79·0	82·8	82·1	80·0
Akyab	88·0	78·1	78·0	89·0	81·7	74·0	89·0	81·7	76·0	85·0	80·1	74·0
False Point	...	81·9	...	...	80·9	...	...	79·9	...	...	80·6	...
Cuttack	86·0	80·0	75·6	88·1	81·1	74·0	88·2	81·9	74·4	88·3	81·5	74·5
Saugor Island	87·1	83·8	80·2	84·1	80·6	76·8	84·7	78·6	72·8	85·4	80·4	74·6
Chittagong	84·7	81·7	75·3	86·9	81·2	73·3	87·7	79·5	73·3	86·7	78·8	71·4
Calcutta	87·5	81·7	77·0	82·0	79·3	77·4	83·2	78·5	74·5	84·8	80·1	76·2
Burdwan	86·5	80·2	75·4	85·5	79·1	73·9	84·0	79·9	77·4	84·5	78·3	74·4
Jessore	88·5	81·8	76·0	83·2	78·6	75·0	85·0	76·6	73·9	88·0	79·6	74·2
Dacca	89·4	80·3	75·5	86·7	81·0	76·0	81·6	77·0	74·2	85·5	78·8	74·0
Silchar	84·7	81·2	73·2	82·7	77·1	71·5	75·7	75·1	70·5	76·7	75·6	70·3
Hazaribagh	73·6	70·1	68·0	72·6	67·6	64·0	76·6	70·6	62·2	81·4	72·8	65·5
Berhampore	84·6	78·1	73·3	84·6	76·1	73·3	82·6	75·8	72·3	82·6	76·9	73·3
Gya	74·1	72·1	68·0	Not recorded.								
Patna	77·8	74·0	71·8	75·4	70·3	68·1	82·6	75·1	68·3	83·8	77·1	72·2
Purneah	87·7	76·7	71·1	79·1	72·3	70·7	78·1	73·0	70·3	80·6	74·8	70·3
Sibsagar	84·9	75·9	70·0	74·3	72·9	72·9	79·2	74·3	70·4	76·4	70·2	66·7
Goalpara	79·7	74·3	69·4	76·2	72·0	70·9	69·9	68·0	66·5	78·9	72·0	68·0
Allahabad	74·1	70·3	68·7	81·4	73·7	68·3	86·1	75·6	67·4	82·7	74·6	67·7
Lucknow	73·2	72·0	70·9	82·7	73·8	65·0	89·4	78·2	67·0	83·2	75·1	67·0
Agra	88·3	80·0	71·6	85·3	76·7	68·1	91·7	81·4	71·1	91·3	79·7	68·1
Roorkee	88·5	76·9	65·3	85·7	75·7	65·8	92·2	79·0	65·8	88·2	77·7	67·3

STATIONS.	13			14			15			16		
	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.
Port Blair	87·0	80·6	75·4	87·5	81·3	76·4	87·5	81·0	76·4	88·0	81·3	76·4
Nancowry	77·1	76·7	75·3	82·1	79·1	75·3	84·1	81·2	77·3	83·1	80·7	77·3
Trichinopoly	95·0	84·8	75·8	96·0	85·0	76·4	93·9	83·9	75·0	94·5	83·9	75·3
Madras	94·3	83·4	77·4	91·8	82·8	74·8	90·4	82·0	73·7	91·6	83·0	76·3
Vizagapatam	83·3	81·8	79·8	84·0	82·4	79·5	84·2	82·8	80·3	83·5	82·0	79·3
Akyab	87·0	80·1	76·0	89·0	80·7	75·0	88·0	80·4	73·0	89·0	80·1	72·0
False Point	...	80·9	...	...	81·7	...	...	80·7	...	...	79·7	...
Cuttack	90·0	82·7	74·5	90·1	82·9	74·8	90·9	82·6	73·7	89·6	81·6	73·0
Saugor Island	86·2	82·7	78·4	86·2	82·3	74·4	86·6	81·9	77·4	86·4	81·5	76·4
Chittagong	87·7	79·6	73·0	86·3	80·2	71·8	87·7	80·4	71·8	87·2	78·2	68·3
Calcutta	84·5	79·8	77·0	84·5	79·7	74·5	87·5	81·2	75·8	86·6	81·1	76·0
Burdwan	87·5	80·6	78·4	85·5	79·5	73·4	89·5	79·7	72·4	89·5	81·4	73·4
Jessore	91·0	80·5	73·8	88·6	79·4	72·0	89·0	78·7	71·2	89·0	80·6	72·0
Dacca	87·8	79·6	73·5	86·0	79·6	75·0	86·8	81·0	75·5	87·8	?	?
Silchar	80·3	77·1	71·0	76·6	73·7	70·8	81·6	76·2	69·3	80·6	76·6	69·1
Hazaribagh	79·8	72·0	65·5	81·6	73·1	63·2	82·1	71·6	64·5	80·8	72·7	65·0
Berhampore	84·6	78·4	73·3	84·6	76·5	71·3	86·6	77·7	70·3	87·6	80·0	73·3
Gya	80·1	76·7	72·0	82·1	76·6	69·4	82·1	73·8	65·6	82·1	72·5	65·4
Patna	79·8	75·1	71·2	83·4	76·4	67·9	83·6	75·8	67·7	83·6	77·6	71·0
Purneah	84·8	76·9	70·3	84·6	77·9	70·3	85·6	78·7	70·3	86·5	78·4	68·1
Sibsagar	80·5	74·7	70·4	80·8	75·3	70·0	75·4	71·7	69·3	79·6	72·1	66·4
Goalpara	81·4	73·3	68·5	82·0	76·7	70·1	83·4	76·3	69·2	83·8	76·4	69·0
Allahabad	83·1	74·8	68·6	88·0	76·5	69·5	84·6	74·0	66·5	83·2	74·1	66·0
Lucknow	87·7	76·3	65·0	90·2	79·1	68·1	81·7	71·6	61·5	84·7	72·8	61·0
Agra	90·8	79·7	68·6	85·3	76·5	67·6	81·3	72·7	64·1	84·8	75·0	65·1
Roorkee	79·2	71·2	63·2	73·3	65·7	58·2	80·7	68·4	56·2	83·0	70·6	58·2

TABLE III—(*Continued*).

STATIONS.	17			18			19			20		
	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.
Port Blair	88·5	81·3	76·4	89·0	81·3	75·9	89·0	81·8	76·9	83·0	78·6	75·9
Nancowry	?	77·6	77·3	80·1	78·2	75·3	81·1	78·6	75·3	80·1	78·7	75·3
Trichinopoly	93·4	81·0	73·6	94·0	83·1	74·0	92·5	83·2	75·9	94·5	80·8	75·0
Madras	88·7	81·6	78·4	91·4	83·1	76·6	90·6	83·2	75·8	92·2	83·2	76·1
Vizagapatam	83·5	80·9	77·7	83·3	81·4	77·8	83·7	81·0	78·0	83·5	80·5	76·5
Akyab	89·0	79·0	69·0	90·0	79·0	69·0	89·0	79·6	71·0	88·0	79·3	70·0
False Point	..	79.6	...	...	79·4	...	...	79·7	...	...	79·4	...
Cuttack	90·3	81·3	71·9	90·6	80·3	72·2	91·6	82·0	73·6	90·5	81·4	72·8
Saugor Island	86·2	81·1	74·4	85·6	79·6	72·4	86·2	80·1	73·6	84·3	79·5	72·2
Chittagong	87·5	78·6	68·3	87·7	79·6	69·4	86·7	79·4	70·6	86·7	78·2	67·0
Calcutta	87·0	80·9	75·5	87·0	81·3	76·5	87·5	81·4	77·0	86·2	79·5	74·5
Burdwan	89·0	79·5	73·4	88·5	80·4	72·4	89·5	79·7	73·4	85·5	79·0	71·9
Jessore	89·0	80·8	72·0	89·7	79·5	72·0	90·0	80·9	72·2	89·8	78·5	71·5
Dacca	87·3	81·1	73·5	87·1	78·5	72·5	87·2	79·3	70·9	86·3	78·4	69·8
Silchar	85·7	76·9	66·8	86·7	77·9	65·8	85·6	76·9	65·8	85·0	75·9	66·8
Hazaribagh	82·1	75·2	67·0	81·8	71·7	63·2	79·6	72·5	64·8	77·8	70·5	62·2
Berhampore	87·6	76·5	72·3	86·6	78·6	71·3	87·6	77·6	72·3	84·6	76·7	71·3
Gya	83·7	73·3	66·0	86·6	74·3	67·2	83·5	77·2	68·8	83·1	76·3	68·4
Patna	85·0	78·2	70·2	84·6	76·4	67·7	83·6	77·1	71·0	82·6	75·9	68·7
Purneah	87·0	78·6	69·3	86·4	77·5	70·2	85·1	77·3	70·3	85·1	76·5	68·3
Sibsagar	79·9	72·1	65·9	83·1	71·4	64·7	82·6	72·7	64·2	78·3	70·8	64·1
Goalpara	83·0	75·1	69·7	82·7	74·7	67·5	83·6	75·1	67·1	83·3	75·3	67·0
Allahabad	85·8	76·4	68·7	86·1	75·1	67·8	82·8	72·5	65·0	81·8	71·9	64·3
Lucknow	84·7	74·3	64·0	80·2	69·9	59·6	82·2	72·6	63·0	85·2	73·6	62·0
Agra	79·3	72·2	65·1	79·3	70·2	61·1	81·3	71·7	62·1	82·8	72·0	61·1
Roorkee	77·2	69·7	62·2	80·7	70·7	60·7	82·2	69·7	57·2	80·7	69·4	58·2

STATIONS.	21			22			23			24		
	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.
Port Blair	86·0	78·5	74·9	87·5	79·6	75·4	87·0	80·5	77·9	87·5	81·8	78·4
Nancowry	80·1	78·1	75·3	81·1	79·2	75·3	82·1	78·6	75·3	83·1	80·2	77·3
Trichinopoly	93·1	83·0	74·0	94·5	82·8	73·7	92·2	81·9	73·4	94·5	80·8	72·3
Madras	91·7	82·0	74·0	92·3	83·1	75·5	91·6	82·7	73·7	91·2	84·0	78·1
Vizagapatam	83·7	81·2	77·5	83·7	81·6	78·3	83·5	80·8	76·4	84·0	81·1	77·5
Akyab	88·5	78·3	69·0	90·0	79·3	70·0	90·0	80·0	71·0	91·0	81·7	73·0
False Point	...	78·6	...	...	78·2	...	...	77·4	...	...	75·9	...
Cuttack	88·8	79·9	71·1	86·4	79·0	70·2	86·9	78·6	69·1	86·6	77·3	65·0
Saugor Island	84·0	77·3	69·7	83·0	76·5	68·0	83·0	76·5	67·6	83·1	77·4	73·0
Chittagong	85·9	78·3	67·8	85·7	76·3	65·4	86·7	76·1	64·8	86·7	77·5	64·8
Calcutta	84·0	78·5	74·0	84·4	78·0	72·0	84·3	77·8	72·5	83·5	77·4	72·7
Burdwan	83·5	77·7	71·4	84·5	77·0	69·4	84·0	76·2	68·9	84·0	76·6	69·4
Jessore	86·0	77·6	70·0	85·0	76·1	68·0	84·0	76·6	68·0	85·0	76·9	67·5
Dacca	84·7	77·9	69·4	84·5	76·3	66·8	85·1	76·8	68·0	85·8	76·8	66·9
Silchar	84·5	75·3	64·5	86·5	75·9	62·3	87·4	76·5	62·2	87·3	77·2	63·2
Hazaribagh	76·8	69·5	61·0	75·8	68·5	60·0	76·6	67·6	59·2	77·1	68·5	59·2
Berhampore	82·6	76·0	69·2	82·6	75·7	69·2	82·6	76·0	69·2	83·6	76·3	69·2
Gya	83·3	74·6	67·0	82·7	72·8	63·6	78·7	72·1	63·0	84·8	73·0	63·0
Patna	82·6	74·7	66·1	82·8	74·8	65·1	82·8	75·4	67·1	82·8	75·2	65·9
Purneah	84·1	76·3	66·8	85·1	75·9	66·3	85·1	77·2	65·7	85·6	77·4	64·7
Sibsagar	80·8	70·8	60·7	82·6	71·1	59·1	83·5	73·3	62·1	83·6	72·8	60·9
Goalpara	81·5	72·9	64·7	81·3	73·3	65·6	82·3	73·7	65·0	82·4	73·8	64·6
Allahabad	82·8	70·8	63·0	83·0	71·8	62·6	82·9	72·3	62·4	83·2	72·3	63·0
Lucknow	83·7	72·1	60·6	83·7	71·9	60·1	84·7	72·4	60·1	86·9	74·4	62·0
Agra	84·3	73·2	62·1	85·8	74·5	63·1	88·3	76·2	64·1	87·3	76·2	65·1
Roorkee	80·2	69·7	59·2	81·7	70·9	60·2	84·2	71·7	59·2	78·7	?	?

TABLE III—(*Concluded*).

STATIONS.	25			26			27			28		
	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.
Port Blair	87·0	81·5	80·4	83·5	77·3	77·9	85·0	76·3	74·4	85·0	78·3	74·9
Nancowry	83·1	80·6	78·3	?	77·7	77·3	77·1	77·1	75·3	78·1	76·7	75·3
Trichinopoly	92·7	82·2	74·0	87·9	79·3	73·1	92·5	76·8	74·4	95·3	79·3	74·6
Madras	90·9	81·8	72·8	85·8	79·7	74·8	84·7	77·3	75·8	86·0	79·7	76·7
Vizagapatam	83·2	80·3	76·6	83·3	80·8	77·5	82·8	81·0	78·0	83·0	80·4	77·0
Akyab	91·0	82·1	74·0	92·0	82·0	74·0	91·0	81·3	73·0	92·0	81·3	73·0
False Point	...	75·9	...	...	75·9	...	...	76·8	...	...	77·1	...
Cuttack	87·2	77·7	66·5	87·6	77·5	64·9	87·4	76·4	65·2	87·6	77·1	65 3
Saugor Island	83·2	75·6	67·4	84·1	77·0	67·6	84·0	75·8	67·4	84·2	76·1	67·8
Chittagong	88·7	80·0	69·0	88·2	79·0	71·0	86·9	79·3	69·8	88·2	78·7	67·8
Calcutta	84·6	77·5	70·5	84·5	77·8	72·0	84·2	77·8	72·5	84·8	77·7	72·5
Burdwan	85·5	77·7	70·4	85·5	77·2	69·9	84·5	75·0	68·9	85·5	81·3	78·4
Jessore	86·0	76·3	66·2	87·0	75·0	65·5	86·0	74·8	65·0	87·0	75·8	66·6
Dacca	86·8	77·3	66·8	86·1	77·6	68·8	85·1	76·6	67·1	86·3	77·2	66·0
Silchar	87·9	77·9	63·4	89·2	79·6	66·8	88·7	78·6	65·8	89·7	78·4	63·4
Hazaribag	77·4	67·7	59·2	76·8	68·6	60·2	76·8	69·6	61·0	78·8	69·6	59·8
Berhampore	83·6	76·3	69·2	84·6	74·5	68·2	83 6	75·9	69·2	84·6	76·2	68·2
Gya	84·8	80·7	72·2	85·4	79·0	72·8	86·4	80·1	72·9	86·2	77·0	73·8
Patna	83·6	76·2	66·7	84·2	76·4	67·7	83·6	75·8	66·1	83·6	76·0	65·9
Purneah	84·9	76·5	65·2	85·1	76·3	65·1	85·6	77·0	65·3	85·5	76·6	64·5
Sibsagar	82·4	71·6	59·7	83·5	70·8	61·6	82·2	71·5	59·4	82·6	71·3	58·5
Goalpara	81·8	72·5	65·9	83·3	74·4	64·6	82·9	74·4	65·1	82·6	73·7	65·1
Allahabad	83·7	73·1	63·9	84·7	73·5	64·2	84·9	73·5	65·1	84·8	72·9	64·5
Lucknow	87·2	75·6	64·0	86·9	74·9	63·0	86·7	74·8	63·0	86·9	74·4	62·0
Agra	87·8	76·5	65·1	88·8	77·5	66·1	88·3	77·0	65·6	86·8	75·5	64·1
Roorkee	82·7	71·4	60·2	84·0	71·6	59·2	83·2	70·9	58·7	82·7	?	?

STATIONS.	29			30			31		
	Max.	Mean.	Min.	Max.	Mean.	Min.	Max.	Mean.	Min.
Port Blair	84·0	78·3	74·9	84·0	78·3	75·4	85·5	79·6	76·9
Nancowry	79·1	77·6	75·3	80·1	78·7	74·3	82·1	79·6	76·3
Trichinopoly	91·9	81·6	73·8	96·4	84·0	73·9	98·3	84·8	74·0
Madras	90·0	78·9	73·2	92·4	79·7	70·1	95·7	79·5	71·1
Vizagapatam	84·0	81·7	78·6	86·5	83·4	79·8	87·0	83·6	82·0
Akyab	88·0	79·4	75·0	85·0	78·8	75·0	85·0	80·5	77·0
False Point	...	78·7	...	...	78·4	...	...	75·9	...
Cuttack	87·6	78·5	67·9	83·2	75·7	72·2	80·8	77·3	74·7
Saugor Island	84·6	77·5	68·4	80·3	76·4	71·8	78·1	72·7	73·0
Chittagong	88·1	80·8	72·0	85·9	76·7	71·8	78·7	75·6	73·8
Calcutta	86·0	78·5	72·0	81·5	77·9	75·3	76·5	73·8	70·5
Burdwan	83·5	76·0	69·4	85·5	76·2	72·4	78·5	75·3	73·4
Jessore	87·0	77·2	67·4	84·5	77·7	72·6	83·0	72·8	73·6
Dacca	87·8	78·3	69·8	85·8	76·8	72·4	76·8	74·6	73·9
Silchar	85·8	77·8	65·8	78·9	75·6	69·4	76·4	74·0	70·1
Hazaribagh	76·8	69·8	62·0	78·4	70·4	61·2	78·4	70·9	63·0
Berhampore	84·6	75·8	68·2	87·6	77·1	70·3	85·6	74·4	73·3
Gya	86·6	79·6	69·2	87·4	80·1	66·9	87·0	80·0	64·2
Patna	84·2	75·8	67·1	84·8	77·0	67·7	86·6	76·7	67·1
Purneah	85·6	77·0	65·0	85·6	76·6	63·7	86·1	76·3	64·8
Sibsagar	82·1	71·9	60·1	81·9	71·4	60·2	76·5	68·9	61·5
Goalpara	81·8	70·7	63·6	83·0	73·5	63·6	75·9	70·3	64·4
Allahabad	83·9	72·5	62·7	83·6	72·2	62·8	83·8	72·7	64·0
Lucknow	85·2	72·6	60·1	85·4	72·0	58·6	84·7	72·8	61·0
Agra	86·8	75·3	63·8	84·8	73·0	61·1	83·8	72·5	61·1
Roorkee	82·2	68·1	54·1	84·2	69·4	54·6	83·7	70·4	57·2

TABLE IV.

Wind Directions—October 1876.

Stations.	1		2		3		4	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	W. N. W.	N.	W. S. W.	W.	W. N. W.	N. W.	N.	W.
Nancowry	W.	S. W.	W.	W. S. W.	S. W.	W.	W. S. W.	W.
Trichinopoly	W.	......	W.	......	W. N. W.	......	W. N. W.	......
Madras	S. S. W.	......	S. W. by S.	......	N. E. by E.	......	N. by E.	......
Vizagapatam	S.	E.	E.	W. by N.	E. by S.	E.	E.	E.
Akyab	S. E.	S.	E.	W.	N. E.	W.	E.	W.
False Point	S. W.	S. W.	W. S. W.	W.	N.	N. E.	N.	N. E.
Cuttack	S. W.	W.	E. N. E.	N.	N. N. E.	E. N. E.	N. N. W.	N. N. E.
Saugor Island	S. W.	S. W.	N.	N.	N. N. E.	N.	N. N. W.	N.
Chittagong	S. E.	W.	N. E.	S. E.	E.	W.	N. E.	W. N. W.
Calcutta	S. S. W.	S.	W.	W. by N.	N.	N. E.	N. E.	N. by E.
Burdwan	S. W.	W.	N.	N. N. W.	N. N. W.	N. N. W.	N. E.	N. N. W.
Jessore	S.	S.	N. E.	E.	S. E.	N.	N. W.	N.
Dacca	S.	S.	?	S. E.	E. N. E.	Calm.	E. N. E.	N. W.
Silchar	E. N. E.	N. W.	E.	S.	Calm.	W.	N. N. E.	W.
Hazaribagh	W. N. W.	W. N. W.	N. W.	N. W.	N. N. E.	N. N. W.	N. W.	W. N. W.
Berhampore	S. W.	W. S. W.	N. N. W.	N.	N. N. E.	N.	N. N. E.	N. W.
Gya	W.	N.	W.	W.	Calm.	Calm.	S.	Calm.
Patna	E. N. E.	E.	E.	E.	Calm.	Calm.	W.	Calm.
Purneah	E.	E.	E. N. E.	E. N. E.	N. E.	N. N. W.	N. N. W.	S. W.
Sibsagar	W. S. W.	W. S. W.	E.	N. N. E.	N. N. E.	N. E.	N. E.	N. E.
Goalpara	E. N. E.	E. S. E.	E. S. E.	E.	E.	N. E.	S. E.	N. W.
Allahabad	N. W.	S. W.	S. W.	N.	N. W.	N. W.	N. W.	N. W.
Lucknow	E. S. E.	N. E.	W. S. W.	N. W.	N. W.	N. W.	N. W.	N. N. W.
Agra	W.	W.	W.	W.	W.	N.	W.	W.
Roorkee	S. E.	N. W.	S. W.	N. W.	W.	N. W.	Calm.	N. W.

Stations.	5		6		7		8	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	S. W.	S. S. E.	S. S. W.	S. W.	W.	S. W.	W. S. W.	W. N. W.
Nancowry	S. W.	S. W.	S. W.	S. W.	W.	S. W.	S. W.	W.
Trichinopoly	N. W.	......	W. N. W.	......	W.	......	W. N. W.	......
Madras	N. by W.	......	N. N. E.	......	S.	......	W. S. W.	......
Vizagapatam	W. S. W.	E.	N. N. W.	N.	W. by N.	N. W.	W.	S. W.
Akyab	N. E.	S.	S. E.	S.	S. E.	S.	S.	S. W.
False Point	N. N. E.	N. N. E.	N. N. E.	N. N. E.	S. E.	S. E.	S. E.	S. E.
Cuttack	N. N. E.	N. N. E.	N. N. E.	N. N. E.	N. N. E.	E.	E.	E. S. E.
Saugor Island	N. E.	N.	E.	E.	N. E.	N. E.	E. S. E.	S. E.
Chittagong	E. N. E.	W. N. W.	E. N. E.	W. S. W.	E. S. E.	W. S. W.	S.	S. S. W.
Calcutta	E. by N.	N. N. E.	E. by N.	S.	E.	E. by N.	E. by S.	E. by N.
Burdwan	N. E.	Calm.	E.	S. W.	N. N. E.	E. S. E.	E. N. E.	N. E.
Jessore	N.	N. N. E.	N. N. E.	N. N. E.	N. N. E.	N. N. E.	N. N. E.	E.
Dacca	E. N. E.	N. N. W.	E. S. E.	?	E. N. E.	?	E. S. E.	E. S. E.
Silchar	E. N. E.	W.	E. N. E.	S.	E. N. E.	Calm.	Calm.	N. E.
Hazaribagh	W. N. W.	N. N. W.	E. N. E.	N.	N. E.	N. N. E.	E.	E. N. E.
Berhampore	E.	N. N. E.	N. N. E.	N. N. W.	N. N. E.	N.	N. E.	N.
Gya	S.	Calm.	Calm.	Calm.	E.	Calm.	E. N. E.	E. N. E.
Patna	Calm.	Calm.	Calm.	Calm.	W.	W.	E.	E.
Purneah	W. S. W.	W. S. W.	W. S. W.	N. N. W.	S. W.	S. E.	N. E.	N. E.
Sibsagar	N. E.	Calm.	E. N. E.	E. N. E.	Calm.	N. N. E.	E. N. E.	E. N. E.
Goalpara	N. E.	W.	E.	Calm.	Calm.	W. N. W.	N. W.	E
Allahabad	S. W.	N.	S. W.	N. E.	N. E.	N. E.	N. E.	N. E.
Lucknow	W. N. W.	N. W.	N. W.	N.	N.	N.	S.	S.
Agra	W.	W.	W.	W.	S. W.	N.	W.	Calm.
Roorkee	Calm.	N. W.	Calm.	Calm.	S. E.	?	S. E.	Calm.

TABLE IV—(*Continued*).

STATIONS.	9		10		11		12	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	W.	W.	S.	W.	E.	W. S. W.	E. N. E.	E.
Nancowry	S. W.	S. W.	S. W.	W. S. W.	S. W.	E. S. E.	E. S. E.	E.
Trichinopoly	W. N. W.	......	W. S. W.	......	W.	......	W. N. W.	......
Madras	S. W. by W.	......	S. W. by W.	......	S. by W.	......	S. by E.	......
Vizagapatam	W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	E.
Akyab	S.	W. N. W.	S	S. E.	S.	S.	E.	S. E.
False Point	S. E.	S.	W.	S. S. W.	S. E.	E.	S.	S.
Cuttack	S.	S. S. W.	W. N. W.	S. W.	Calm.	W. N. W.	N. N. E.	N. N. E.
Saugor Island	S. E.	S. S. E.	S. S. W.	S. S. E.	N. W.	N. E.	S. S. E.	S. S. W.
Chittagong	N. E.	S.	S. E.	S.	E. S. E.	S. W.	S. E.	S. W.
Calcutta	E. S. E.	S. E.	S.	S.	N. N. E.	E.	S. S. E.	S. S. W.
Burdwan	E.	E.	S. S. E.	S.	N. N. E.	Calm.	N. E.	Calm.
Jessore	N. E.	N. N. E.	S.	S.	W.	S. W.	S.	S.
Dacca	E. S. E.	S. S. W.	S. S. E.	S. S. E.	S. S. W.	S.	S.	S. S. E.
Silchar	N. E.	N.	N.	N. N. E.	N. E.	E. N. E.	N. E.	Calm.
Hazaribagh	E. N. E.	E. N. E.	W. S. W.	W. N. W.	Calm.	N. E.	S. S. E.	S. E.
Berhampore	N. E.	N. N. E.	S. S. E.	S. E.	N.	N. N. W.	N. N. E.	E.
Gya	W.	W.	W.	W. N. W.	E. S. E.	E.	S. W.	W.
Patna	E.	E.	N. E.	N. E.	W.	Calm.	E.	E.
Purneah	E. N. E.	N. E.	N. E.	N. E.	E.	E. S. E.	E. N. E.	E. N. E.
Sibsagar	E. N. E.	E. N. E.	E.	S. S. W.	S. S. E.	E N. E.	E. N. E.	E. N. E.
Goalpara	E.	E.	E. N. E.	E. N. E.	E.	E.	E.	Calm.
Allahabad	N.	N.	N. W.	S. W.	S. W.	E. N. E.	N. N. W.	N. N. W.
Lucknow	S.	S.	?	?	W.	N. W.	E. S. E.	N. E.
Agra	S. W.	E.	W.	W.	Calm.	W.	W.	S. W.
Roorkee	S. E.	Calm.	Calm.	N. W.	S. E.	S. E.	S. E.	Calm.

STATIONS.	13		14		15		16	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	W. N. W.	E.	E.	E.	E.	E.	E. N. E.	E.
Nancowry	E. S. E.	S. E.	E. S. E.	S. E.	S. E.	E. S. E.	S. S. W.	W. S. W.
Trichinopoly	W.	......	W.	......	E. N. E.	......	N.	......
Madras	S. S. E.	......	S. by E.	......	E.	......	E.	......
Vizagapatam	S. W.	E.	E.	E.	S. E.	S. E.	S. E.	S. E.
Akyab	S.	S. S. W.	S.	S.	E.	W.	N.	W. N. W.
False Point	S. W.	S. W.	Calm.	S.	S.	S.	S.	S. S. E.
Cuttack	N.	Calm.	S. S. E.	Calm.	N. E.	Calm.	Calm.	S.
Saugor Island	S. W.	S. W.	N. N. W.	W. N. W.	S.	S. S. W.	W.	S. S. W.
Chittagong	S. S. E.	W.	S. E.	W. S. W.	E. N. E.	W.	N. E.	N. W.
Calcutta	S. W.	S. S. W.	W. by S.	W. S. W.	S. S. W.	S. S. W.	S. S. W.	S. W.
Burdwan	S. W.	S.	W.	W.	S. W.	N. W.	W.	Calm.
Jessore	S.	W.	W.	W.	W.	N. N. E.	N. N. E.	W. S. W.
Dacca	S. S. W.	S.	S. S. W.	S. W.	W.	N. W.	S. W.	S. W.
Silchar	E. N. E.	S. S. E.	E.	E. S. E.	E.	Calm.	E.	N.
Hazaribagh	S. W.	N. W.	W. N. W.	W.	S. E.	W. N. W.	W. N. W.	W. N. W.
Berhampore	S. S. W.	S. W.	W. N. W.	S. W.	N. W.	S. W.	S. W.	S. W.
Gya	S. W.	W.	W.	Calm.	S.	N.	S.	Calm.
Patna	W.	Calm.	W.	W.	W.	Calm.	Calm.	Calm.
Purneah	E.	E.	E. N. E.	N. W.	E. N. E.	E. N. E.	S. W	N. W.
Sibsagar	E. N. E.	W.	E. N. E.	S. S. W.	S. S. W.	N. N. E.	E. S. E.	E.
Goalpara	E.	S. E.	Calm.	Calm.	S. E.	W.	E.	W.
Allahabad	N. E.	N. E.	E.	E.	S. S. E.	N. E.	N. E.	E. N. E.
Lucknow	W. S. W.	S. S. W.	S.	S. S. W.	S. S. E.	S. S. E.	S. S. E.	N. N. W.
Agra	S.	S. W.	N.	N.	S. W.	N.	Calm.	E.
Roorkee	N. E.	Calm.	S. E.	E.	S. E.	Calm.	Calm.	Calm.

TABLE IV—(*Continued*).

STATIONS.	17		18		19		20	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	N. N. E.	W. N. W.	N. N. E.	N. E.	W. N. W.	N. E.	N. E.	N. E.
Nancowry	N. W.	S. W.	N. E.	S. W.	S. W.	S. W.	N.	N. E.
Trichinopoly	N. N. E.	......	E.	......	E. S. E.	......	N. E.	......
Madras	E.	......	E. by S.	......	E.	......	E. N. E.	......
Vizagapatam	E.	E.	E.	E.	S. E.	S.	S. E.	E.
Akyab	N. E.	W. N. W.	N. N. W.	W.	N.	W.	E.	W.
False Point	S. S. E.	S. S. E.	Calm.	E.	Calm.	S. E.	N. W.	E.
Cuttack	W. S. W.	Calm.	Calm.	Calm.	W.	Calm.	W.	W.
Saugor Island	S. W.	S. S W.	N. W.	N. N. W.	N. W.	W. N. W.	W. N. W. to N. N. W.	N.
Chittagong	N. E.	N. N. E.	N. E.	N. N. E.	N. E.	N.	N.	W. N. W.
Calcutta	S. W.	S. S. W.	S. W.	W. by N.	W.	W. by S.	N. N. W.	N.
Burdwan	S.	S.	N.	N. N. W.	W.	S.	N.	Calm.
Jessore	W.	N. E.	N. E.	E. N. E.	N. E.	N. E.	N. E.	E.
Dacca	W.	W.	Calm.	S.	N. E.	N. N. W.	N. W.	N. E.
Silchar	Calm.	N. N. E.	E.	E.	E.	W.	E. N. E.	N.
Hazaribagh	W.	W. N. W.	S. S. E.	N. W.	W. N. W.	N. W.	W.	N. W.
Berhampore	S. S. W.	W. S. W.	N. E.	S. W.	S.	E. N. E.	N.	N. W.
Gya	S.	E.	Calm.	Calm.	Calm.	W.	Calm.	N.
Patna	Calm.	W.	W. S. W.	W.	W.	W.	W.	W.
Purneah	N. W.	W. N. W.	E. N. E.	W. S. W.	N. W.	N. W.	N. W.	W.
Sibsagar	E. S. E.	E. S. E.	Calm.	E. S. E.	E. S. E.	E. N. E.	Calm.	S. S. W.
Goalpara	N. E.	E. N. E.	E. S. E.	E. S. E.	E.	W.	E.	W.
Allahabad	N. E.	E.	S. E.	Calm.	Calm.	Calm.	N. W.	W. S. W.
Lucknow	E. S. E.	S. E.	N.	N.	N.	N. W.	W. N. W.	N. W.
Agra	E.	E.	W.	N. E.	N.	N. W.	N. W.	S. W.
Roorkee	N. E.	S. E.	S. E.	S.	N. W.	N. W.	S. W.	N. W.

STATIONS.	21		22		23		24	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	N.	N. E.	N. E.	E. S. E.	E.	E. S. E.	E.	E. S. E.
Nancowry	W. S. W.	W.	W. S. W.	S. E.	S. E.	S. E.	S. E.	S. E.
Trichinopoly	N. E.	......	E.	......	N. E.	......	N. N. E.	......
Madras	E. N. E.	......	E. N. E.	......	N. E. by E.	......	N. E. by N.	......
Vizagapatam	E.	S. E.	S. E.	S. E.	S. E.	S. E.	E.	E.
Akyab	E.	W. S. W.	N.	W.	N. E.	W.	N. E.	W.
False Point	N. N. E.	E.	N.	E. N. E.	N.	N.	N.	N. N. E.
Cuttack	N.	N. E.	N. E.	N. E.	N. E.	N. E.	W. N. W.	N.
Saugor Island	N. N. E.	N.	N. N. W.	N.	N.	N.	N.	N.
Chittagong	N. N. E.	N.	N. E.	N. W.	N. E.	W.	N. N. E.	W. N. W.
Calcutta	N. by E.	N. N. W.	N. N. E.	N. by E.	N. E.	N.	N. by W.	N. W.
Burdwan	N.	N.	N.	N.	N.	N.	N.	N.
Jessore	E. N. E.	N. E.	N. E.	N. E.	E. N. E.	N. E.	E. N. E.	N. E.
Dacca	N. E.	N. W.	N. W.	Calm.	N. E.	W. N. W.	N. W.	N. N. W.
Silchar	E.	E.	E.	S.	N. W.	W. N. W.	E. S. E.	Calm.
Hazaribagh	W. S. W.	N. W.	N. N. W.	W. N. W.	N. W.	N.	Calm.	W. N. W.
Berhampore	N. W.	N. W.	N. N. W.	N. W.	N W.	N. W.	N. N. W.	E. N. E.
Gya	Calm.	N.	E.	Calm.	Calm.	N.	N. W. .	W.
Patna	Calm.	W.	W. N. W.	W. N. W.	W.	W.	W.	Calm.
Purneah	W.	N. W.	N. W.	N. W.	N. N. W.	N. N. E.	N. E.	N. E.
Sibsagar	E.	E. N. E.	E. N. E.	E. N. E.	E. N. E.	E. N. E.	E. N. E.	E. S. E.
Goalpara	E. S. E.	Calm.	E.	S. E.	E.	Calm.	E.	E.
Allahabad	S. W.	N.	S. W.	Calm.	S. W.	Calm.	N. E.	N. N. E.
Lucknow	W. N. W.	N. N. W.	W.	N. W.	N. W.	N. N. W.	W. N. W.	N. N. W.
Agra	S.	W.	W.	W.	W.	N. W.	W.	N. W.
Roorkee	S.	N. W.	W.	Calm.	S. E.	Calm.	S. E.	S. E.

TABLE IV—(*Concluded*).

STATIONS.	25		26		27		28	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	E. S. E.	E.	E.	E.	E.	E. S. E.	S. E.	S. S. E.
Nancowry	S. E.	S. E.	S. E.	S. S. E.	S. S. W.	S.	S. S. W.	S. S. W.
Trichinopoly	S. W.	......	N.	......	N. W.	......	E.	......
Madras	N. E. by N.	......	Calm.	......	N. by E.	......	Calm.	......
Vizagapatam	E.	S. E.	E.	E.	E.	E.	E.	E.
Akyab	E. N. E.	S. W.	N. N. E.	W.	N. E.	W.	N. E.	S.
False Point	N.	N.	N.	N. E.	N. W.	E. N. E.	N.	N. E.
Cuttack	N.	N.	W. N. W.	N. E.	W.	N. N. E.	N. N. E.	N. N. E.
Saugor Island	N.	N.	N. N. W.	N.	N. W.	N.	N. N. W.	N.
Chittagong	N. N. E.	W. N. W.	N.	W. N. W.	N. N. E.	W. N. W.	N. N. E.	W.
Calcutta	N. N. E.	N. by W.	N. W.	W.	W. by N.	W. N. W.	N. by W.	N. N. W.
Burdwan	N.	N.	N. N. W.	N. N. W.	N.	N.	N.	N.
Jessore	E. N. E.	N. E.	N. N. E	N. E.	N. N. E	N. N. E.	N.	S. E.
Dacca	N. E.	S. W.	N.	W. N. W.	S. S. W.	S.	N.	S
Silchar	N. N. E.	Calm.	E. N. E.	W. N. W.	E. N. E.	E.	E.	W. N. W.
Hazaribagh	N. E.	N. W.	N.	N. W.	W. N. W.	N. W.	E.	N. N. W.
Berhampore	N. N. W.	N. N. W.	N. N. W.	N. W.	N. W.	N.	N. N. E.	N. E.
Gya	S. E.	Calm.	S.	S. E.	E.	E.	E.	E.
Patna	W.	W.	W.	W.	Calm.	W.	W.	W.
Purneah	E.	N. E.	N. E.	N.	N. N. E.	N.	N. E.	E. N. E.
Sibsagar	E. S. E.	E. S. E.	Calm.	E. S. E.	E. S. E.	E. N. E.	E. N. E.	E. N. E.
Goalpara	E.	E.	E.	S. E.	E.	E.	E. S. E.	E. N. E.
Allahabad	Calm.	Calm.	S. W.	N.	N. W.	N. W.	W.	N.
Lucknow	W.	N. W.	W.	N. W.	W. N. W.	N. N. W.	N. N. W.	N. W.
Agra	W.	W.	W.	W.	W.	N. W.	W.	W.
Roorkee	Calm.	W.	Calm.	N. W.	Calm.	Calm.	S. E.	Calm.

STATIONS.	29		30		31	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	S. E.	S. S. E.	S. E.	S. S. E.	S.	S.
Nancowry	S. W.	S. W.	S. W.	S. S. W.	S. S. W.	S. W.
Trichinopoly	N. N. W.	......	S. W.	......	W. N. W.	......
Madras	Calm.	......	Calm.	......	N. by W.	......
Vizagapatam	S. E.	S. E.	N.	W.	W. S. W.	S. by E.
Akyab	N.	E.	N. E.	N. E.	E S. E.	S. E.
False Point	N.	N. E.	N. N. E.	N. E.	N.	N.
Cuttack	N.	N. E.	E. N. E.	N. E.	N.	N.
Saugor Island	N. N. E.	N.	N. E.	E.	N. N. E.	N. N. E.
Chittagong	N. E.	S. W.	S. E.	N. N. E.	N.	N. E.
Calcutta	N. N. E.	N.	E.	N. E.	N. E.	N. E.
Burdwan	N.	N.	N. N. E.	E. S. E.	N.	N. E.
Jessore	N. E.	E. S. E.	S. E.	S. E.	N. E.	N. E.
Dacca	N. E.	N. N. E.	E. N. E.	Calm.	N. N. E.	N.
Silchar	E.	Calm.	N. E.	E. N. E.	E.	E. N. E.
Hazaribagh	N.	N. N. W.	N. E.	N. N. E.	N. N. E.	N.
Berhampore	N. W.	E.	N.	E. N. E.	E. N. E.	N. E.
Gya	Calm.	Calm.	Calm.	E.	W.	N.
Patna	Calm.	Calm.	S. W.	W. N. W.	E.	E.
Purneah	E. N. E.	E. N. E.	E. N. E.	E.	E. N. E.	E. N. E.
Sibsagar	Calm.	E. N. E.	E. N. E.	E. N. E.	E. N. E.	Calm.
Goalpara	E. S. E.	E. N. E.	E.	E.	E.	E.
Allahabad	Calm.	Calm.	N. E.	N. E.	N. E.	N. E.
Lucknow	N. W.	N. W.	N. W.	N. E.	W. N. W.	W. N. W.
Agra	W.	W.	W.	N.	N.	N. W.
Roorkee	S. E.	N. W.	S. E.	Calm.	S. E.	Calm.

TABLE V.

Daily wind velocities—October 1876.

STATIONS.	1	2	3	4	5	6	7	8
Nancowry	125·4	126·3	137·7	179·3	177·8	172·8	248·6	217·2
Trichinopoly	65·0	79·0	111·0	77·0	114·0	162·0	158·0	184·0
Madras	108·0	101·0	141·0	117·0	95·0	101·0	83·0	168·0
Vizagapatam	8·3	6·1	16·0	50·7	41·3	90·0	204·6	788·5
Akyab	34·0	35·0	46·0	44·0	59·0	76·0	67·0	56·0
Cuttack	74·7	35·8	45·8	47·6	71·6	111·9	197·9	144·6
Saugor Island	273·0	121·7	101·3	118·0	155·4	120·9	164·7	273·0
Chittagong	140·2	79·4	80·7	95·8	72·8	60·2	53·7	114·8
Calcutta	182·9	83·9	88·5	66·3	69·0	82·6	63·8	155·4
Burdwan	132·0	63·2	62·5	56·8	28·5	47·7	54·5	133·7
Jessore	106·9	53·4	46·0	59·6	48·7	19·2	42·1	62·4
Dacca	150·0	110·0	45·0	25·0	45·0	34·0	36·0	75·0
Silchar	74·5	63·2	39·5	72·2	52·0	60·1	63·2	46·0
Hazaribagh	265·6	123·9	60·3	68·8	86·9	76·5	118·4	285·3
Berhampore	85·0	20·2	24·7	35·2	34·8	25·3	49·9	70·0
Gya	77·2	10·6	6·9	11·6	13·5	6·1	12·0	71·9
Patna	62·6	23·9	28·5	14·5	20·9	31·3	34·0	91·7
Purneah	127·0	47·0	22·0	41·0	36·0	16·0	27·0	72·0
Sibsagar	74·1	77·4	41·3	41·2	56·3	36·9	45·0	72·6
Goalpara	101·0	110·2	37·2	37·4	34·9	39·1	13·2	56·2
Allahabad	52·1	26·9	49·7	57·1	39·7	28·2	28·3	53·7
Lucknow	39·0	42·0	53·0	43·0	42·0	18·0	28·0	33·0
Agra	67·7	69·4	106·2	96·0	61·2	50·4	29·2	44·5
Roorkee	55·6	40·7	36·3	35·6	41·9	25·3	59·3	145·5

STATIONS.	9	10	11	12	13	14	15	16
Nancowry	177·6	73·7	49·4	20·7	38·7	12·3	33·6	17·4
Trichinopoly	177·0	167·0	193·0	131·0	130·0	111·0	84·0	116·0
Madras	198·0	171·0	156·0	60·0	100·0	99·0	84·0	121·0
Vizagapatam	Out of order.							
Akyab	28·0	89·0	62·0	30·0	32·0	48·0	42·0	51·0
Cuttack	211·9	129·7	44·5	46·5	33·0	39·0	34·7	31·5
Saugor Island	462·8	439·5	133·6	141·8	207·2	144·9	139·0	121·0
Chittagong	88·3	155·6	176·6	106·7	91·0	108·6	93·9	95·8
Calcutta	143·4	306·2	147·6	41·7	37·1	70·2	54·2	47·8
Burdwan	166·6	123·3	80·7	47·4	46·0	76·1	40·9	50·1
Jessore	268·4	35·7	80·3	69·0	33·0	83·0	34·0	47·9
Dacca	65·0	185·0	145·0	45·5	98·5	78·0	34·0	36·0
Silchar	84·9	108·3	77·4	79·4	59·0	39·0	54·9	74·7
Hazaribagh	374·2	410·7	123·2	126·4	158·2	119·0	121·5	138·8
Berhampore	49·9	85·1	25·2	29·7	30·2	54·9	25·2	34·9
Gya	155·2	101·7	51·6	26·7	55·9	16·2	49·9	23·8
Patna	104·3	198·6	102·6	38·3	44·1	34·9	30·7	29·5
Purneah	162·0	275·0	172·0	74·0	36·0	39·0	19·0	81·0
Sibsagar	77·9	80·9	63·5	81·7	41·9	57·4	61·2	68·9
Goalpara	331·8	235·6	277·0	216·1	96·4	61·6	50·2	27·1
Allahabad	135·5	85·5	46·8	49·3	31·2	37·1	59·6	47·1
Lucknow	79·0	86·0	41·0	72·0	53·0	62·0	69·0	25·0
Agra	132·5	107·8	64·5	63·9	97·4	128·0	84·0	46·2
Roorkee	76·9	61·1	49·4	45·9	23·6	185·3	20·2	24·2

TABLE V—(*Concluded*).

STATIONS.	17	18	19	20	21	22	23	24
Nancowry	7·0	9·0	7·3	42·7	43·3	75·4	38·9	48·2
Trichinopoly	121·0	131·0	135·0	115·0	162·0	116·0	117·0	93·0
Madras	75·0	86·0	109·0	179·0	138·0	139·0	216·0	270·0
Vizagapatam	Out of order.					29·7	69·3	37·7
Akyab	62·0	50·0	41·0	39·0	42·0	41·0	40·0	50·0
Cuttack	34·4	29·4	27·6	38·0	32·4	41·0	53·4	49·3
Saugor Island	111·0	67·6	105·0	114·5	133·3	159·7	165·9	157·5
Chittagong	102·1	78·2	95·1	82·3	90·4	114·2	89·9	112·2
Calcutta	40·5	36·5	44·4	68·3	91·3	101·1	120·2	63·2
Burdwan	33·0	38·1	26·9	60·0	56·7	37·0	47·9	50·3
Jessore	31·1	31·0	38·0	47·6	42·4	28·0	69·0	49·0
Dacca	40·0	34·7	30·3	48·0	69·0	55·4	26·6	57·0
Silchar	60·3	61·4	69·5	59·7	63·7	52·0	58·2	58·1
Hazaribagh	89·0	92·3	99·2	87·1	55·4	73·8	69·8	66·1
Berhampore	24·7	30·2	35·2	24·8	39·9	34·9	30·3	49·8
Gya	37·5	14·0	27·4	32·1	13·7	12·9	9·1	11·2
Patna	31·1	22·5	44·2	39·2	10·1	22·9	40·3	29·8
Purneah	25·0	30·0	18·0	57·0	50·0	24·0	27·0	24·0
Sibsagar	65·0	33·9	31·0	41·4	57·4	29·4	31·1	39·7
Goalpara	37·8	80·2	25·0	29·0	91·7	60·2	80·4	102·8
Allahabad	31·0	52·9	60·5	38·7	28·2	17·3	17·9	22·4
Lucknow	65·0	78·0	53·0	41·0	36·0	31·0	26·0	31·0
Agra	155·1	66·8	76·0	63·0	71·4	71·9	71·6	70·2
Roorkee	72·2	52·6	31·1	26·2	28·0	31·5	21·4	28·7

STATIONS.	25	26	27	28	29	30	31
Nancowry	64·0	254·1	310·8	29·9	1·2	16·4	26·7
Trichinopoly	126·0	164·0	93·0	68·0	61·0	93·0	112·0
Madras	249·0	230·0	164·0	206·0	189·0	148·0	136·0
Vizagapatam	84·6	59·0	85·5	71·7	97·9	85·0	133·1
Akyab	35·0	38·0	40·0	35·0	27·0	69·0	110·0
Cuttack	48·8	43·2	38·6	38·7	65·0	161·5	232·2
Saugor Island	129·5	117·1	102·0	124·0	184·1	173·4	527·6
Chittagong	110·9	70·6	92·5	102·0	131·3	92·0	142·3
Calcutta	72·1	45·4	34·7	26·3	24·0	42·7	215·7
Burdwan	33·1	35·8	49·5	28·8	30·4	58·3	95·7
Jessore	26·8	24·2	27·0	23·4	35·0	64·0	110·6
Dacca	37·0	31·0	36·0	27·0	70·0	58·5	77·5
Silchar	57·8	59·9	43·2	66·4	64·3	81·8	72·3
Hazaribagh	65·7	64·4	88·7	73·5	86·6	99·6	153·9
Berhampore	40·3	29·9	29·9	30·2	34·9	50·0	60·0
Gya	10·8	9·8	8·4	4·6	8·2	11·8	9·8
Patna	20·2	18·6	23·7	34·0	19·5	16·9	22·6
Purneah	20·0	30·0	25·0	40·0	48·0	73·0	86·0
Sibsagar	37·0	36·2	38·1	33·5	53·0	39·0	50·1
Goalpara	130·0	155·9	102·8	145·7	152·6	218·2	228·5
Allahabad	18·8	23·1	21·1	21·2	20·8	25·8	29·6
Lucknow	22·0	37·0	25·0	21·0	23·0	16·0	19·0
Agra	58·3	56·7	75·2	60·0	45·9	63·1	55·9
Roorkee	20·1	27·8	33·7	27·2	33·0	31·2	22·1

TABLE VI.

Humidity Table for October 1876.

STATIONS.	1		2		3		4		5	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	81	95	85	93	93	83	95	95	91	91
Nancowry	87	85	86	82	86	86	87	82	86	90
Trichinopoly	53	43	59	47	55	43	50	45	58	49
Madras	66	72	58	50	37	53	61	62	62	57
Vizagapatam	75	72	72	62	67	67	74	74	68	68
Akyab	75	75	75	67	75	72	76	79	78	71
False Point	83	79	79	79	83	79	76	79	79	79
Cuttack	75	62	71	65	68	68	68	62	68	62
Saugor Island	83	79	87	79	87	83	83	72	72	76
Chittagong	80	76	90	88	76	71	78	71	76	75
Calcutta	83	77	83	70	81	85	79	71	73	76
Burdwan	76	73	83	69	83	69	76	62	76	73
Jessore	73	79	81	86	76	89	83	74	71	70
Dacca	74	86	93	95	78	91	76	74	72	71
Silchar	89	83	81	85	87	64	77	63	73	61
Hazaribagh	88	89	80	72	67	60	63	53	67	48
Berhampore	79	69	72	72	83	65	65	59	72	59
Gya	88	82	73	61	65	60	61	56	66	45
Patna	69	73	71	67	64	63	65	54	61	54
Purneah	79	85	61	70	81	66	74	59	72	55
Sibsagar	84	82	84	80	84	66	76	77	81	65
Goalpara	97	85	90	78	83	68	73	69	74	65
Allahabad	76	66	71	62	64	57	65	54	62	58
Lucknow	72	54	64	43	50	43	53	36	47	34
Agra	65	44	58	49	53	41	51	41	46	46
Roorkee	71	45	58	38	49	37	49	37	58	35

STATIONS.	6		7		8		9		10	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	79	77	83	87	89	95	93	91	89	85
Nancowry	95	90	91	86	78	78	82	78	78	83
Trichinopoly	55	44	59	48	53	39	50	40	50	39
Madras	52	67	65	48	44	24	39	51	38	57
Vizagapatam	77	56	65	75	86	82	77	76	61	65
Akyab	72	75	75	71	72	75	94	85	65	82
False Point	82	95	83	79	83	79	83	83	83	91
Cuttack	86	86	86	86	86	75	86	75	70	61
Saugor Island	95	90	91	95	79	75	75	76	82	91
Chittagong	69	74	78	73	74	71	75	76	77	75
Calcutta	83	88	98	93	88	83	81	73	92	84
Burdwan	76	83	87	87	86	87	87	74	78	75
Jessore	72	80	80	79	79	83	76	74	93	66
Dacca	70	74	77	79	76	81	78	87	85	79
Silchar	61	82	77	70	83	77	71	72	82	75
Hazaribagh	61	47	74	90	93	93	88	89	85	86
Berhampore	65	65	62	58	86	82	87	83	74	82
Gya	57	54	80	76	87	91	98	93	Not recorded.	
Patna	84	62	69	63	86	88	93	93	96	98
Purneah	64	63	87	85	93	88	60	82	95	88
Sibsagar	75	63	95	80	92	96	85	70	93	96
Goalpara	81	62	85	80	97	97	86	82	95	95
Allahabad	57	50	55	51	77	88	97	96	81	74
Lucknow	47	37	63	47	60	47	88	93	69	66
Agra	57	42	52	37	55	43	70	52	65	53
Roorkee	57	38	60	44	61	50	63	52	61	57

TABLE VI—(*Continued*).

STATIONS.	11		12		13		14		15	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	83	79	83	77	83	74	79	77	80	80
Nancowry	79	79	79	76	79	90	83	74	75	76
Trichinopoly	54	38	54	38	53	40	50	39	48	44
Madras	58	72	60	58	53	67	53	58	57	58
Vizagapatam	68	64	78	77	77	71	79	75	76	75
Akyab	75	71	81	71	82	74	82	72	78	76
False Point	83	79	78	79	75	83	79	79	75	72
Cuttack	68	68	75	57	71	59	72	59	72	52
Saugor Island	76	75	76	74	76	75	76	73	76	68
Chittagong	81	72	93	72	94	67	77	66	70	61
Calcutta	90	77	80	69	81	80	73	61	75	55
Burdwan	77	75	83	87	76	87	74	64	72	67
Jessore	87	65	75	72	66	68	68	65	68	66
Dacca	94	78	87	75	72	75	73	71	68	53
Silchar	80	84	78	86	78	80	93	88	86	71
Hazaribagh	73	69	73	71	72	62	53	47	76	48
Berhampore	82	71	82	82	82	68	82	67	71	64
Gya	Not recorded.				82	77	81	69	73	66
Patna	80	72	82	76	82	82	76	69	71	65
Purneah	88	90	87	73	76	79	77	67	78	54
Sibsagar	85	82	92	87	85	79	86	78	92	90
Goalpara	99	96	94	77	87	84	78	74	81	67
Allahabad	75	72	85	73	89	75	76	70	79	66
Lucknow	60	52	72	60	52	57	62	37	68	65
Agra	57	32	44	27	57	35	60	50	77	54
Roorkee	67	54	64	51	63	81	94	54	59	50

STATIONS.	16		17		18		19		20	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	81	78	80	78	79	76	83	78	93	83
Nancowry	76	71	79	90	83	87	83	83	95	83
Trichinopoly	58	42	67	45	57	46	56	57	54	75
Madras	58	70	78	70	65	62	62	60	60	64
Vizagapatam	73	69	73	71	73	70	70	56	71	69
Akyab	74	71	66	73	66	67	74	67	74	67
False Point	75	75	75	75	78	71	78	71	63	75
Cuttack	71	58	71	52	71	68	64	68	67	52
Saugor Island	73	68	75	68	80	68	83	65	71	68
Chittagong	79	64	75	58	66	61	74	55	81	62
Calcutta	71	62	74	62	69	60	73	60	73	59
Burdwan	77	69	76	81	76	66	64	85	70	64
Jessore	61	60	62	63	64	61	61	62	63	64
Dacca	73	57	69	59	72	79	68	59	68	66
Silchar	76	68	82	57	68	58	66	57	75	59
Hazaribagh	68	56	62	43	73	52	53	62	56	54
Berhampore	71	55	75	62	67	61	68	62	87	75
Gya	80	76	79	80	77	74	71	67	69	72
Patna	74	59	70	58	72	65	75	68	68	57
Purneah	68	54	69	58	74	74	76	72	72	55
Sibsagar	87	72	81	72	97	64	89	62	88	79
Goalpara	80	63	88	61	86	61	79	65	78	61
Allahabad	73	67	79	58	70	71	75	57	67	57
Lucknow	61	49	75	61	55	68	65	48	64	36
Agra	65	39	71	45	67	54	61	47	54	41
Roorkee	56	56	89	78	55	58	57	70	73	58

TABLE VI—(*Concluded*).

STATIONS.	21		22		23		24		25	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	85	85	83	81	81	81	81	79	80	83
Nancowry	83	78	83	79	83	78	79	79	79	74
Trichinopoly	60	45	53	45	57	44	60	50	57	40
Madras	58	60	54	57	48	51	53	60	49	49
Vizagapatam	71	63	60	53	56	60	55	50	48	54
Akyab	73	63	70	79	74	71	75	68	72	68
False Point	71	59	66	59	52	45	52	56	62	56
Cuttack	71	47	63	50	56	43	59	47	56	46
Saugor Island	60	60	71	56	61	57	71	58	71	55
Chittagong	63	52	70	60	73	66	69	61	68	55
Calcutta	65	49	67	53	62	55	72	53	58	52
Burdwan	70	57	70	53	65	54	71	56	70	53
Jessore	63	57	60	56	61	60	59	60	57	55
Dacca	66	46	60	57	61	54	61	47	51	52
Silchar	71	53	71	51	61	46	66	46	60	45
Hazaribagh	53	53	52	48	55	52	56	51	56	52
Berhampore	66	53	63	56	66	49	66	40	59	56
Gya	65	71	65	65	63	61	61	58	57	64
Patna	59	57	61	51	57	58	64	52	67	49
Purneah	70	55	65	57	66	52	62	47	60	59
Sibsagar	70	58	75	60	79	61	72	57	79	61
Goalpara	81	58	79	61	76	63	70	63	81	68
Allahabad	63	71	64	56	59	60	67	59	63	63
Lucknow	58	37	54	40	55	41	56	42	56	42
Agra	52	41	48	39	40	35	42	41	48	38
Roorkee	78	57	68	52	68	56	74	69	68	53

STATIONS.	26		27		28		29		30		31	
	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.	10 h.	16 h.
Port Blair	83	91	81	91	83	83	87	85	85	85	83	85
Nancowry	79	90	90	86	79	90	78	86	79	83	76	74
Trichinopoly	61	53	66	85	71	62	64	48	55	37	50	31
Madras	65	69	86	85	76	66	65	41	41	49	40	51
Vizagapatam	53	55	52	52	52	52	46	49	52	48	71	62
Akyab	75	68	79	71	79	71	77	78	81	74	74	78
False Point	58	59	62	56	58	62	67	62	82	82	90	82
Cuttack	60	47	62	53	59	47	53	54	77	77	70	67
Saugor Island	66	57	66	57	72	60	60	58	92	82	86	94
Chittagong	77	59	70	71	86	68	74	64	81	89	86	91
Calcutta	68	53	66	56	59	54	70	58	79	79	86	90
Burdwan	70	61	70	75	70	60	81	60	74	81	91	79
Jessore	61	60	60	60	67	60	68	56	83	74	94	95
Dacca	50	58	59	53	48	58	70	57	75	86	85	92
Silchar	69	57	76	53	62	51	64	64	74	78	81	79
Hazaribagh	56	52	56	50	55	50	60	46	58	57	65	52
Berhampore	74	59	70	50	55	50	70	57	70	61	91	86
Gya	60	83	60	58	79	78	54	54	70	45	53	53
Patna	66	58	68	60	66	56	68	56	65	52	68	52
Purneah	68	54	60	55	62	53	58	52	61	48	54	56
Sibsagar	94	59	77	51	78	49	76	57	72	56	82	76
Goalpara	77	67	65	66	77	63	76	83	74	58	81	73
Allahabad	66	54	66	58	69	56	59	59	69	58	65	54
Lucknow	58	26	55	43	56	36	58	40	61	44	58	46
Agra	45	32	51	38	54	35	48	31	47	30	53	34
Roorkee	66	53	63	50	69	51	63	42	63	54	64	50

TABLE VII.

Rainfall.

TABLE

Rain

Recorded at Stations in

Division.	Districts.	Stations.	1	2	3	4	5	6	7	8	9	10
Bengal.	**Western Districts.**											
Burdwan ...	Burdwan	Burdwan	...	...	...	...	...	...	0·02	0·46	0·57	1·71
		Cutwa	...	...	...	...	...	...	0·80	0·40	...	1·10
		Culna	...	...	...	...	...	...	0·45	0·65	...	1·60
		Bood-Bood	...	...	...	...	...	0·16	0·25	0·30	0·44	3·50
		Ranoegunge	...	...	...	...	...	...	0·53	0·15	...	3·26
		Jehanabad	1·11	...	...	...	...	0·34	0·66	1·11	0·06	2·71
	Bankoora	Bankoora	0·16	...	...	...	...	0·12	0·59	0·85	2·08	4·25
	Soory	Soory	...	...	...	...	...	...	0·45	0·23	0·30	2·34
		Hetampore	0·05	...	...	...	...	...	0·50	0·40	0·19	2·88
		Roypore	...	...	...	...	...	...	...	0·98	0·12	2·65
	Midnapore...	Midnapore	0·01	0·10	...	...	...	0·01	0·35	1·42	0·10	4·75
		Tumlook	...	...	1·85	...	...	...	1·25	...	3·20	...
		Ghatal	0·50	...	...	...	...	0·38	0·83	1·07	1·36	1·50
		Contai	...	1·07	1·08	...	...	1·07	1·48	0·77	0·98	...
	Hooghly	Hooghly	0·65	0·05	...	...	...	0·03	0·93	0·11	0·60	0·65
		Serampore	...	1·24	0·39	0·01	...	...	1·20	1·40	0·02	0·63
	Howrah	Howrah	0·04	...	0·02	...	0·06	0·37	1·50	0·68	0·25	0·52
		Mohisrakha	...	0·50	0·20	0·54	...	0·10	2·00	0·22	0·02	1·10
Presidency ...	24-Pergunnahs	Saugor Island	1·16	0·17	0·20	...	...	...	3·55	0·58	...	2·25
		Calcutta	...	...	0·03	0·71	...	0·35	1·59	1·10	...	0·62
		Alipore (Jail)	0·03	0·01	0·03	0·17	0·03	0·46	1·46	0·86	0·37	0·72
		Bussoerhat	...	0·46	...	...	...	...	1·25	...	0·40	1·00
		Baraset	0·45	...	...	...	...	...	1·68	0·91	0·70	2·10
		Diamond Harbour	0·46	...	0·21	...	...	0·22	1·71	0·78	...	0·33
		Barripore	0·08	...	0·55	0·02	...	0·31	2·28	0·79	0·46	0·18
		Satkhira	0·20	...	0·04	...	...	...	1·00	0·83	0·11	0·86
		Barrackpore	1·42	0·25	...	...	...	...	1·16	1·18	0·02	0·65
		Dum-Dum	...	...	0·10	...	...	0·02	0·40	1·90	0·03	0·37
	Nuddea	Kishnaghur	...	0·05	0·62	0·07	...	...	0·32	0·48	0·50	1·71
		Bongong	...	...	3·60	...	...	0·55	0·34	...	0·20	1·20
		Meherpore	...	...	0·08	...	...	...	0·23	1·40	0·29	1·36
		Chooadanga	0·06	...	...	0·14	...	...	0·05	0·10	0·36	0·25
		Kooshtea	0·96	...	...	...	...	...	...	0·68	...	0·45
		Ranaghat	...	...	0·62	...	...	...	0·53	...	0·92	0·73
	Jessore	Jessore	0·04	0·01	1·45	...	...	0·04	0·23	0·15	0·25	1·57
		Narail	0·31	0·06	...	0·85	...	...	0·24	0·40	...	0·65
		Khoolna	0·19	0·02	...	0·11	...	...	0·64	...	0·46	0·12
		Jhenidah	0·75	2·45	...	0·15	...	...	...	0·95	0·15	0·55
		Bagirhat	...	...	...	...	0·94	...	0·75	...	...	...
		Magoora	0·11	0·31	0·33	...	...	...	0·06	1·50	0·09	0·90

VII.

FALL

Bengal in October 1876.

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL.
...	...	...	...	...	...	...	...	...	0·24	...	...	...	...	...	...	...	...	...	......	......	3·00
0·02	0·10	...	0·24	...	...	0·25	...	...	0·35	...	...	...	...	...	...	...	...	...	0·65	......	3·91
0·96	...	...	0·24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·27	......	4·17
0·15	...	...	0·15	...	0·22	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	5·17
...	...	...	...	...	0·05	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	3·99
0·09	...	0·15	0·34	...	...	0·13	...	...	...	...	...	...	...	...	...	...	...	...	......	......	6·70
...	0·44	...	...	...	...	0·17	...	...	...	...	...	...	...	...	...	...	...	...	0·36	0·08	9·10
...	...	0·01	...	...	...	...	...	...	0·19	...	...	...	...	...	...	...	...	...	......	......	3·52
...	...	...	...	...	0·10	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	4·12
...	...	...	...	...	...	0·39	...	...	...	...	...	...	...	...	...	...	...	...	0·68	0·18	5·00
...	0·04	0·38	...	...	...	...	...	...	2·22	...	...	...	...	...	...	...	...	...	0·02	0·07	9·47
0·40	...	0·34	...	...	...	...	...	...	0·20	...	...	...	...	...	...	...	...	...	0·50	0·14	7·88
0·16	...	0 65	...	...	...	...	...	...	0·26	...	...	...	...	...	...	...	...	....	0·08	0·05	6·84
...	...	...	...	...	...	...	...	...	0·75	...	...	...	...	...	...	...	...	...	0·75	0·30	8·25
...	0·10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·15	0·35	3·62
0·38	0·02	0·01	0·17	0·01	...	...	...	...	0·03	...	...	...	...	...	...	...	...	...	0·05	0·35	5·91
0·32	0·01	0·18	0·18	...	...	...	...	...	0·04	...	...	...	...	...	...	...	...	...	......	0·29	4·46
1·69	...	...	...	...	...	...	...	...	0·15	...	...	...	...	...	...	...	...	...	......	0·23	6·75
0·65	0·10	...	0·08	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·20	0·49	9·43
0·42	0·10	...	0·44	...	...	...	...	0·04	...	...	...	...	...	...	...	...	...	...	......	0·40	5·80
0·45	0·24	0·04	0·18	...	...	...	...	...	0·06	...	...	...	...	...	...	...	...	...	0·01	0·25	5·37
0·09	...	...	0·03	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	0·65	3·88
...	...	...	0·31	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·15	0·19	6·49
0·48	0·02	0·22	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·03	0·22	4·68
0·21	...	...	0·17	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	0·51	5·56
0·19	0·11	...	0·12	...	...	...	...	...	0·98	...	...	...	...	...	...	...	...	...	......	0·52	4·96
0·38	0·01	...	0·30	...	...	0·01	...	...	0·03	...	...	...	...	...	...	...	...	...	......	0·31	5·72
3·05	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	0·06	5·93
1·04	...	1·21	0·58	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·07	0·05	6·70
...	...	...	0·38	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	0·32	6·59
0·12	0·09	...	0·31	...	...	...	...	...	0·13	...	...	...	...	...	...	...	...	...	0·73	0·10	4·84
0·63	0·10	...	0·18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	0·18	2·05
...	0·03	...	...	...	...	...	...	0·06	...	...	...	...	...	...	...	...	...	...	1·00	0·30	3·48
...	1·22	0·63	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	0·22	4·87
0·01	...	0·01	...	...	...	...	...	...	0·25	...	...	...	...	...	...	...	...	...	0·07	0·25	4·33
0·03	0·35	...	0·20	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	0·29	3·38
0·02	...	0·02	0·02	...	...	...	...	...	0·09	...	...	...	...	...	...	...	...	...	0·59	1·03	3·31
0·10	0·80	0·15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·11	0·89	7·05
...	0·10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	1·79
0·12	0·06	0·06	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	0·25	3·79

VII—(*Continued*).

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL.
0·15	...	0·10	0·07	...	...	0·21	...	...	...	...	...	...	...	...	...	...	...	...	......	0·11	1·35
...	...	...	...	...	2·22	0·56	...	0·09	...	...	...	...	...	...	...	...	...	...	......	......	5·59
...	0·08	0·20	1·00	...	0·07	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	2·57
...	...	...	0·24	...	...	0·43	...	0·07	...	...	...	...	...	...	...	...	...	...	......	......	1·55
0·92	0·29	0·33	1·43	0·40	0·62	...	0·10	...	...	...	...	...	...	...	...	...	...	...	......	......	6·15
0·32	...	0·95	0·17	...	...	0·07	...	...	...	...	...	...	...	...	...	...	...	...	......	......	3·23
0·38	...	0·09	...	...	...	0·22	...	0·09	0·38	...	...	...	...	...	...	...	...	...	0·61	0·16	3·35
2·57	0·04	...	0·05	...	...	...	...	0·02	...	...	...	...	...	...	...	...	...	...	......	......	12·31
0·20	...	...	0·30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	12·98
0·27	...	0·75	0·04	0·06	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	3·65
0·15	0·03	0·11	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	......	......	8·16
0·05	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·20	......	4·02
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	4·09
0·62	...	...	0·05	0·01	...	...	...	0·13	...	...	...	...	...	...	...	...	...	...	......	......	11·44
0·38	...	0·05	...	...	0·46	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	7·17
2·40	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	12·51
6·90	...	...	0·01	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	......	......	6·70
...	0·08	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	1·80
0·30	...	...	...	...	...	...	0·75	...	...	...	...	...	...	...	...	...	...	...	......	......	4·00
...	...	0·75	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	4·27
0·15	...	0·50	...	...	...	...	0·50	...	...	...	...	...	...	...	...	...	..	...	......	......	4·95
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	12·50
0·03	0·39	0·98	...	...	0·52	...	...	0·02	...	...	...	...	...	...	...	...	...	...	0·12	0·19	6·63
0·10	...	2·35	...	...	...	...	1·00	...	...	...	...	...	...	...	...	...	...	...	......	......	5·50
0·56	1·40	...	0·27	0·02	0·05	...	...	...	0·14	...	...	0·22	...	...	...	...	...	...	......	......	6·91
1·45	...	...	...	0·60	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	6·73
0·98	0·38	0·12	1·51	...	...	...	1·16	...	...	..	...	...	...	...	...	...	...	...	......	......	10·00
2·13	...	...	...	...	...	0·23	0·34	0·18	...	...	...	...	...	...	...	...	...	...	......	......	10·37
...	...	0·50	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	3·89
1·29	...	...	4·00	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	9·94
0·11	...	0·19	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·04	0·14	2·77
0·15	0·10	0·95	...	...	...	...	0·30	...	...	...	...	...	...	...	...	...	...	...	......	......	6·43
0·07	0·91	0·55	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	0·43	4·93
0·09	...	0·01	...	...	...	...	...	0·47	...	...	...	...	...	...	...	...	...	...	0·20	0·89	3·95
0·56	1·08	1·20	...	...	...	0·56	...	...	...	...	...	...	...	...	...	...	...	...	......	0·17	5·61
0·07	0·37	0·31	...	...	...	0·50	...	...	...	...	...	...	...	...	...	...	...	...	......	0·04	4·42
0·26	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·01	0·36	2·34
0·60	0·15	1·05	...	...	...	...	0·05	...	...	...	...	...	...	...	...	...	...	...	......	0·60	5·79
0·56	1·05	...	0·15	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·17	0·19	0·90	4·78
0·90	0·05	0·40	0·08	...	...	...	...	...	...	...	...	...	...	...	...	...	...	?	?	?	2·33?

TABLE

DIVISION.	DISTRICTS.	STATIONS.	1	2	3	4	5	6	7	8	9	10
	EASTERN DISTRICTS—(*Continued*).											
DACCA—(*Contd.*).	Mymensingh	Mymensingh	0·84	0·02	...	...	...	0·01	0·03	2·22	0·02	2·03
		Jamalpore	1·95	...	...	...	...	...	...	0·70	...	...
		Atia	0·62	...	...	0·11	...	...	...	0·31	0·07	0·34
		Kishoregunge	...	0·77	1·02	...	...	...	0·04	...	0·01	0·65
CHITTAGONG	Chittagong	Chittagong	..	0·17	...	...	...	...	...	...	...	0·42
		Cox's Bazar	...	...	...	...	...	...	...	...	1·35	0·14
	Noakholly	Noakholly	0·03	0·72	...	...	...	...	...	2·68	0·25	0·07
		Fenny	0·08	0·05	...	...	...	...	0·12	0·35	0·05	0·11
	Tipperah	Comillah	...	...	0·37	...	...	...	...	0·31	0·02	0·07
		Brahmunberiah	...	0·18	...	...	...	0·43	...	1·60	0·12	...
	Chittagong Hill Tracts	Rangamatee	0·32	...	...	..	...	...	...	...	...	2·04
	Hill Tipperah	Hill Tipperah	0·35	0·03	...	...	...	0·40	...	0·29	...	...
BEHAR.												
PATNA	Patna	Patna	0·10	...	...	...	...	...	...	0·26	0·51	3·21
		Behar	0·18	...	...	...	...	...	0·05	0·88	0·36	2·85
		Barh	...	...	...	...	...	...	...	0·44	0·25	2·84
		Dinapore	...	...	...	...	...	...	...	0·17	0·57	3·60
	Gya	Gya	0·13	...	...	...	...	...	0·10	1·97	0·80	2·87
		Nowada	0·04	...	...	...	...	...	0·23	0·83	0·31	1·80
		Aurungabad	...	...	...	...	...	...	...	0·96	1·24	0·85
		Jehanabad	0·80	0·43	...	...	...	...	0·10	0·48	0·30	3·16
	Shahabad	Arrah	0·03	0·03	0·03	...	...	...	0·01	0·32	0·37	2·20
		Sasseram	...	...	...	...	...	...	1·33	0·33	0·28	...
		Buxar	..	...	...	...	...	...	...	0·94	0·36	0·76
		Bhubooah	...	...	...	...	...	...	...	0·17	0·07	...
	Mozufferpore	Mozufferpore	...	...	...	...	...	...	...	0·25	0·60	3·51
		Hajeepore	0·55	...	...	...	...	...	...	0·60	3·11	2·95
		Seetamurhee	0·30	...	...	...	...	...	...	0·18	3·57	3·37
	Durbhunga	Durbhunga	...	...	...	...	...	...	...	0·52	0·44	1·32
		Mudhoobunnee	...	...	...	...	...	...	...	...	0·30	0·98
		Tajpore	...	...	...	...	...	...	...	...	0·60	2·20
	Sarun	Chupra	...	...	...	...	...	...	...	0·30	0·63	2·50
		Sewan	...	...	...	...	...	...	...	0·24	1·42	2·18
	Chumparun	Motiharee	...	...	...	...	...	...	...	0·05	0·35	2·76
		Bettiah	...	...	...	...	...	...	...	...	...	2·90
BHAGULPORE	Monghyr	Monghyr	0·75	...	...	...	...	...	0·28	1·61	0·11	2·17
		Begooserai	1·38	...	...	...	...	...	...	0·90	0·05	1·50
		Jamooee	0·33	...	...	...	...	...	0·64	1·22	1·24	0·24

VII—(*Continued*).

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL.
0·26	2·12	0·07	...	0·01	0·09	0·18	0·01	0·01	...	...	...	...	...	...	...	...	...	...	......	0·26	8·18
0·69	...	0·07	...	...	0·40	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	3·81
0·13	...	0·32	...	...	...	...	...	...	0·19	...	...	...	...	...	...	...	...	...	......	0·08	2·17
0·55	0·41	0·07	0·01	...	...	...	...	0·20	...	...	...	...	...	...	...	...	...	...	......	0·06	3·79
0·40	...	...	0·45	0·07	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	0·10	1·61
...	...	0·24	0·01	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·46	0·06	2·26
0·03	0·19	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	0·26	4·23
0·70	0·07	0·04	1·35	0·03	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	0·11	3·06
0·68	0·20	0·72	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·18	......	2·55
1·06	0·06	1·70	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·13	0·06	5·34
1·15	...	...	0·33	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	3·84
0·60	0·39	0·44	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·21	0·05	2·76
...	...	1·16	...	0·21	...	...	0·06	...	...	...	...	...	...	...	...	...	...	...	......	......	5·51
...	...	0·42	...	0·37	0·36	...	...	0·14	...	...	...	...	...	...	...	...	...	...	......	......	5·61
0·40	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	3·93
0·77	...	0·15	...	0·30	0·10	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	5·66
0·05	...	0·06	...	0·24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	6·22
...	...	0·50	...	0·20	...	0·22	...	...	...	...	...	...	...	...	...	...	...	...	......	......	4·13
...	...	...	...	0·18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	3·23
...	...	0·88	0·12	0·26	...	...	0·21	...	...	...	...	...	...	...	...	...	...	...	......	......	6·74
0·33	0·33	0·01	...	0·36	...	...	0·21	...	...	...	...	...	...	...	...	...	...	...	......	......	4·23
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	1·94
...	...	...	...	...	...	...	0·35	0·20	...	...	...	...	...	...	...	...	...	...	......	......	2·61
...	...	...	...	...	...	...	0·30	...	...	...	...	...	...	...	...	...	...	...	......	......	0·54
0·32	...	0·55	...	...	...	0·70	...	...	...	...	...	...	...	...	...	...	...	...	......	......	5·93
0·05	0·75	0·85	...	0·65	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	9·51
...	0·21	...	...	0·13	...	...	0·04	...	...	...	...	...	...	...	...	...	...	...	......	......	7·80
0·19	...	0·96	...	...	...	...	0·23	...	...	...	...	...	...	...	...	...	...	...	......	......	3·66
0·29	...	1·62	...	...	...	...	0·21	...	...	...	...	...	...	...	...	...	...	...	......	......	3·40
0·30	...	0·65	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	3·75
3·71	0·05	0·61	...	0·21	...	...	0·12	...	...	...	...	...	...	...	...	...	...	...	......	......	8·13
1·26	0·43	1·73	0·13	0·09	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	7·48
3·67	...	...	...	0·31	...	...	1·03	...	...	...	...	...	...	...	...	...	...	...	......	......	8·17
3·42	0·21	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	6·53
0·15	...	0·13	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	5·20
0·31	...	...	...	0·17	0·42	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	4·73
...	0·12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	3·79

TABLE

DIVISION.	DISTRICTS.	STATIONS.	1	2	3	4	5	6	7	8	9	10
BEHAR—(*Contd.*).												
BHAGULPORE—(*Continued*).	Bhagulpore	Bhagulpore	2·37	0·01	...	...	...	...	0·01	3·02	...	2·05
		Soopool	0·34	...	...	...	...	...	...	0·89	...	0·56
		Muddehpoora	0·64	...	...	...	...	...	...	0·90	0·20	1·20
		Banka	2·23	0·02	...	...	...	...	0·30	0·57	...	1·20
		Sonbursa	0·83	...	...	...	...	...	...	1·21	0·08	1·45
	Purneah	Purneah	2·32	...	0·09	...	...	...	0·02	0·87	0·04	1·63
		Kissengunge	1·14	...	0·09	...	...	...	0·04	0·73	0·04	1·41
		Arrareah	0·94	...	...	...	...	...	...	1·65	1·20	...
	Sonthal Pergunnahs	Nya Doomka	0·36	...	...	...	...	...	0·83	0·21	0·36	1·86
		Deoghur	1·92	...	...	...	...	...	0·65	0·48	0·36	1·50
		Rajmehal	0·07	0·03	0·02	...	...	...	...	0·10	...	...
		Godda	...	...	...	...	...	...	0·55	0·43	...	0·81
ORISSA.												
ORISSA	Cuttack	Cuttack	...	...	...	0·20	...	0·55	0·54	1·44	1·68	...
		Jajpore	...	...	...	0·80	...	1·30	1·30	1·30	0·30	2·50
		Kendrapara	...	...	0·10	...	...	0·70	1·70	0·40	1·40	...
		Jugutsingpore	...	...	...	...	...	2·80	1·20	0·80	0·80	...
		False Point	1·40	...	...	...	...	2·70	2·00	0·70	3·70	4·70
	Pooree	Pooree	0·50	...	...	...	...	1·41	1·77	1·55	0·47	0·37
		Khoordah	0·17	...	...	...	0·30	0·82	0·60	2·42	2·47	...
	Balasore	Balasore	0·05	...	...	0·04	...	1·45	4·16	0·95	2·55	0·75
		Bhuddruck	0·20	0·60	...	...	...	1·79	1·30	0·29	2·39	0·44
		Jellasore	...	0·60	0·04	...	...	0·45	2·70	0·83	1·09	2·96
		Sora	...	...	...	...	0·40	1·60	0·62	0·90	4·43	...
		Chandbally	...	...	...	...	...	1 65	2·55	...	1·00	1·35
	Cuttack Tributary Mehals	Sumbulpore	...	...	...	...	...	...	...	0·15	3·27	...
	CHOTA NAGPORE.											
	Hazaribagh	Hazaribagh	0·07	0·01	...	0·01	...	...	1·28	0·70	1·55	1·65
		Pachumba	0·30	...	...	...	...	...	0·40	0·58	0·22	4·64
	Lohardugga	Ranchee	...	...	...	...	...	...	0·69	0·36	3·50	0·91
		Palamow	...	...	...	...	...	...	0·08	0·10	0·50	0·55
	Singbhoom	Chyebassa	...	...	...	...	...	0·20	0·22	0·57	3·60	...
	Manbhoom	Purulia	1·16	...	...	...	...	...	0·44	0·16	3·28	4·16
		Govindpore	0·60	...	...	...	...	...	0·38	0·90	2·10	1·60
	ASSAM AND ADJACENT HILLS.											
	Sylhet	Sylhet	0·57	1·17	...	...	...	...	...	0·25	...	1·10
	Cachar	Silchar	0·57	0·28	...	...	...	...	...	...	...	0·95
		Hailakandi	0·23	1·76	...	...	...	...	...	0·03	...	0·44
		Jafferbund	0·55	...	...	...	...	...	...	...	...	0·76
	Goalpara	Goalpara	2·26	0·14	...	...	...	...	...	2·00	0·32	1·28
		Dhubri	3·20	...	...	...	...	...	...	2·80	2·30	2·05

VII—(*Continued*).

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL.
0·19	...	0·84	...	...	...	...	...	0·04	...	...	...	...	...	...	...	...	...	...	......	......	8·53
...	...	0·60	...	...	...	...	0·76	...	...	...	...	...	...	...	...	...	...	...	......	......	3·15
0·80	...	0·80	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	4·54
...	...	...	...	...	0·16	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	4·48
0·24	...	1·18	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	4·99
0·09	...	0·02	...	...	...	...	0·03	...	...	...	...	...	...	...	...	...	...	...	......	......	5·11
0·30	...	...	0·41	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	4·16
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	3·79
...	...	...	...	...	0·10	0·11	...	...	...	...	...	...	...	...	...	...	...	...	......	......	3·83
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	4·91
...	...	0·40	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	0·62
...	...	...	0·25	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	2·04
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·48	......	4·89
2·50	...	...	...	...	...	...	0·40	...	0·20	0·60	...	...	...	...	...	...	...	...	......	......	11·20
...	0·10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·10	......	4·50
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·30	......	5·90
...	...	0·20	...	...	...	...	...	...	...	0·35	...	...	...	...	...	...	...	...	1·80	0·90	18·45
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·52	0·05	6·64
...	0·16	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0·10	......	7·04
...	0·08	...	...	...	...	...	0·03	0·02	...	...	...	...	...	...	...	...	...	...	0·17	0·07	10·32
0·26	...	0·15	...	...	...	...	...	0·46	...	...	...	...	...	...	...	...	...	...	......	......	7·88
...	...	...	...	...	...	...	...	0·10	...	...	...	...	...	...	...	...	...	...	......	......	8·77
...	...	...	...	...	...	...	...	...	0·10	...	...	...	...	...	...	...	...	...	......	......	8·05
...	...	...	...	...	...	...	...	...	...	0·70	...	...	...	...	...	...	...	...	0·03	0·17	7·45
...	...	...	...	...	...	...	...	...	0·35	...	...	...	...	...	...	...	...	...	......	......	3·77
0·03	0·31	0·01	0·01	0·02	...	...	...	0·04	0·01	...	...	...	...	...	...	...	...	...	......	......	5·70
0·01	...	...	...	0·06	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	6·21
0·47	...	0·30	0·04	0·33	1·19	...	...	...	...	...	...	...	...	...	...	...	...	...	......	0·09	7·88
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	1·23
0·07	...	...	...	...	...	...	...	0·13	...	...	...	...	...	...	...	...	...	...	......	0·11	4·90
...	...	...	...	...	0·12	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	9·32
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	5·58
1·26	0·67	1·29	0·21	1·05	0·45	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	8·02
0·69	0·48	0·09	0·36	0·71	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	4·13
0·57	0·47	0·03	0·78	0·35	...	...	...	...	...	...	...	...	...	...	0·03	...	...	...	......	......	4·69
0·44	0·38	0·65	0·70	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	3·48
1·78	0·19	...	...	0·14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	8·11
0·70	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.....	......	10·95

TABLE

DIVISION.	DISTRICTS.	STATIONS.	1	2	3	4	5	6	7	8	9	10
ASSAM AND ADJACENT HILLS—(*Continued*).												
	Garo Hills	Tura	0·27	0·17	0·07	...	...	...	...	0·71	...	1·38
	Kamrup	Gauhati	0·30	0·21	...	...	...	...	...	0·77	0·02	1·81
		Barpeta	1·55	0·12	...	...	...	...	...	2·38	0·14	1·82
	Darrang	Tezpore	...	0·02	...	...	...	...	...	...	0·70	1·37
		Mangaldai	0·08	0·02	...	...	...	...	...	0·73	0·15	2·80
	Nowgong	Nowgong	0·12	0·01	...	...	...	...	0·89	0·76	0·05	1·37
	Sibsagar	Sibsagar	0·78	0·37	...	...	0·16	...	0·07	0·38	0·48	0·84
		Jorhat	1·09	...	...	1·40	...	...	0·79	1·20	0·15	0·16
		Golaghat	0·68	0·74		...	...	...	0·14	...	0·19	1·39
		Deopanie	0·13	0·20	...	...	...	...	0·10	0·30	0·30	0·90
		Hattie Pootie	0·12	0·24	...	1·24	...	...	0·54	0·30	0·28	0·90
		Mazengah	0·11	0·12	...	0·09	...	0·01	0·65	0·38	0·18	1·00
		Nazira	0·33	0·08	...	0·03	...	...	0·10	...	0·75	1·20
		Suntock	0·04	0·06	0·27	0·04	0·16	...	...	1·00	0·13	0·61
		Cheridio	0·08	0·44	0·01	...	...	...	...	0·48	0·46	0·17
	Lakhimpur	Dibrugarh	0·30	0·50	...	...	...	...	...	2·12	0·27	0·28
		Sadiya	0·59	0·59	...	...	...	...	...	0·35	0·50	...
		North Lakhimpur	2·06	0·32	...	...	0·03	...	...	0·26	0·15	1·12
	Khasi and Jaintia Hills	Shillong	0·24	0·79	0·80	0·20	0·24	0·58	0·24	0·79	...	1·24
		Jawai	0·20	2·30	1·10	2·10	0·30	...	0·20	0·10	0·30	1·40
		Cherrapoonjee	1·21	4·20	...	0·03	...	0·10	...	1·38	...	3·13
	Naga Hills	Samaguting	0·15	...	...	...	0·29	...	0·13	0·21	...	0·74

VII—(*Concluded*).

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	TOTAL.
4·43	0·17	...	0·70	0·12	0·23	...	...	0·09	...	...	0·06	...	...	...	...	...	...	...	......	......	8·40
0·44	0·17	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	3·72
1·13	0·05	0·03	...	0·19	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	7·41
1·00	0·52	...	0·02	0·20	...	0·02	...	...	0·26	...	...	...	...	...	...	...	...	...	......	......	4·11
0·83	0·31	...	0·03	0·38	...	...	...	...	...	00·1	...	...	...	...	...	...	...	...	......	......	5·33
0·63	0·29	...	...	0·23	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	4·35
0·05	0·75	0·07	0·17	0·15	0·08	0·02	...	...	...	...	...	...	...	...	...	...	...	...	......	......	4·37
0·02	0·80	0·05	0·21	0·52	1·05	0·30	...	...	1·06	...	...	...	...	...	...	...	...	...	......	......	8·80
0·67	0·45	0·65	0·12	0·26	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	5·29
0·60	0·40	0·06	0·21	1·10	0·40	...	...	...	...	0·56	...	...	...	...	...	...	...	...	0·15	0·53	5·94
0·54	0·30	0·21	0·19	0·81	0·39	0·19	...	...	0·09	...	...	...	...	...	...	...	...	...	......	0·18	6·52
0·43	0·46	1·01	0·07	0·37	0·25	0·01	0·01	...	0·04	...	...	...	...	0·01	...	...	0·01	...	0·10	0·44	5·75
...	0·40	0·36	0·05	...	0·29	0·02	0·01	0·01	...	0·05	...	...	...	...	...	...	...	...	......	......	3·68
1·26	0·30	0·43	0·12	0·34	0·36	...	...	...	...	0·03	...	...	...	...	...	...	...	...	......	......	5·15
1·00	0·50	0·65	0·05	0·06	0·29	0·06	...	...	0·03	0·03	...	...	...	...	...	...	...	...	......	0·07	4·38
0·12	0·26	...	1·03	1·15	0·37	0·03	...	...	...	...	...	...	...	...	...	...	...	...	......	......	6·43
0·65	0·10	0·10	0·67	0·67	1·67	0·30	...	...	...	...	...	...	...	...	...	...	...	...	......	......	6·19
1·13	0·65	...	0·35	0·50	1·00	1·00	...	...	...	0·46	...	...	...	...	...	...	...	...	......	......	9·03
0·24	0·78	0·78	0·26	0·94	...	...	...	...	...	...	...	...	...	...	...	...	...	...	......	......	8·14
0·70	0·20	2·40	3·20	0·40	1·20	0·10	0·10	...	0·10	...	...	...	...	...	...	...	...	...	......	0·10	16·50
2·82	0·83	1·48	...	...	...	...	...	...	0·08	...	...	...	...	...	...	...	...	...	0·31	0·19	15·76
0·01	0·39	0·16	0·02	0·02	...	...	...	...	...	0·13	...	...	...	...	...	...	...	...	......	0·78	3·03

SECTION II.

THE VIZAGAPATAM CYCLONE.

CHAPTER I.

THIS section gives all the special information bearing on the Vizagapatam cyclone which I have been able to obtain. The first part consists of the logs of six vessels which, with the exception of the log of the ship *Tenasserim*, were obtained for me by the Master Attendant of the Port of Calcutta. The log of the *Tenasserim*, which is a very complete one, and valuable for the light it throws on the meteorology of a large portion of the Bay during this period, was kindly forwarded to me by the master of the vessel, Captain R. J. Balderstone.

The remaining part of the section gives a most valuable series of observations taken at the private observatory of Mr. A. V. Nursingrow during the advance of the cyclone and its passage over Vizagapatam. I am also indebted to him for the general information which follows of the passage of the cyclone over Vizagapatam and its neighbourhood, including the towns of Bimlipatam and Vizianagram.

Log of the Barque "Ann," from Muscat towards Calcutta.

Hour.	Knots.	Fathoms.	Courses.	Winds.	WEATHER.
THURSDAY, THE 5TH OCTOBER 1876.					
P. M.					
1	...	...	......	Calm ...	Light rain and calm, with gloomy-looking weather; no steerage way. Barometer 29·70.
2					
3					
4					
5					
6	...	...	E.S.E. ...	N.E. ...	Light winds and drizzling rain. 9 P. M.—Wind increasing gradually, but smooth sea.
7					
8					
9					
10					
11					
12	...	...	......	......	Increasing breeze; in topgallant sails and stowed jib and mainsail. Dark and cloudy weather. Pumps carefully attended to every four hours.
A. M.					
1					
2					
3					
4					
5					
6	...	...	E.N.E. ...	N.	Sent down royal-yards; weather threatening; a swell rising from N.W. 10 A. M.—Threatening appearance; wind increasing; stowed upper topsails; heavy sea rising from N.W. Barometer 29·60. No observations.
7					
8					
9					
10					
11	...	...	......	......	Latitude by account 15° 39′ N.
12	...	...	......	......	Longitude by ditto 88° 30′ E.

FRIDAY, THE 6TH OCTOBER 1876.

Hour.	Knots.	Fathoms.	Courses.	Winds.	WEATHER.
P. M.					
1	...	...	N.E. ...	N.N.W. ...	Drizzling rain, with increasing gale and falling barometer, 29·50. Made preparation for bad weather, and passed preventive lashings round boats, spars, &c. Very heavy cross sea.
2	...	...	N.N.W.		
3					
4	...	...	W.		
5					
6	...	...	......	......	From noon till 2 P.M. increasing gale; spanker blew out of the bolt rope; sea still increasing; reefed the foresail.
7					
8					
9					
10	...	...	......	......	4 P.M.—Gale still increasing; barometer 29·85. Furled the lower topsails and passed preventer gaskets round sails; ship under reefed foresail, fore-topmast staysail, and mizzen staysail; the sea washing fore and aft; ship making very bad weather of it, and straining heavily; hands constantly at the pumps; making a great deal of water.
11					
12					
A. M.					
1					
2					
3					
4					
5					
6					
7	...	...	......	......	5 P.M.—Mizzen staysail blew away; also fore-topmast staysail; ship rolling frightfully; terrific storm blowing.
8					
9					
10	...	...	......	......	6 P.M.—Foreyard went in the slings; cut away the wreck. Barometer 29·30.
11					
12	...	...	......	......	7 P.M.—Blowing a hurricane; fore-topmast went at the cap, taking jibboom, the wreck falling portside, loosening the lashings of port anchor; the wreck beating to windward and crushing alongside, had to cut it all away, as also the port anchor, for the safety of vessel. All hands constantly at the pumps; sounded 3 feet water in the well; barometer 29·30. 7·30.—Tremendous squall struck the ship, heaving her right on her beam ends; main topmast went by the cap, mizzenmast went by the board to starboard. Lee quarter-boat immersed and gone; cut away the wreck; as it was breaking her up to leeward. After cutting masts, ship righted.

10 P.M.—Still blowing a hurricane; sea breaking fore and aft and breaking adrift boats, &c., and all moveable things about the deck; had to clear the decks and throw overboard all moveable things to work the pumps. All hands at the pumps, and the pumps not sucking. Sounded 5 feet water in the well; barometer 29·35.

Midnight.—Wind veered to S.W. slightly; less rain; ship heading N.E. Frightful sea breaking fore and aft. From midnight to 6 A.M. all hands at the pumps; sounded 6 feet water in the well.

6 A.M.—Ship still making so much water told off a gang to lighten ship, and began throwing cargo overboard. Threw overboard about 300 bags dates and afterwards red ochre, and about 500 maunds of salt; found the pumps gaining on the leak. Noon.—Wind and sea moderating.

SATURDAY, THE 7TH OCTOBER 1876.

Hour.	Knots.	Fathoms.	Courses.	Winds.	WEATHER.
P. M.					
1	...	...	N.E. ...	S.W. ...	Fine appearance; barometer rising Hands employed constantly at the pumps. Throwing cargo overboard. Pumps gaining on the leak. Found all the water tanks had leaked out in consequence of the lashings breaking.
2					
3					
4					
5					
6	...	...	......	......	Same wind, and weather improving; confused sea; stopped throwing cargo overboard, as the pumps gaining on the leak; all hands at the pumps.
7					
8					
9					
10					
11					
12	...	...	......	......	Less wind and sea; barometer 29·90.
A. M.					
1					
2					
3					
4					
5					
6					
7					
8	...	...	......	......	Pumps sucked for the first time.
9					
10					
11					
12					

HAJEE MAHOMED,
Commander.

Log of the " Fuzzel Kurrim" of the 5th instant.

Wind from north, with heavy rain and squalls. Vessel under close reefed fore-topsails, foresails, and fore-topmast staysails. Wind increasing; lost foresail and fore-topmast staysail. Heavy seas washing on board; immediately sent down the topgallant and royal yards. Sounded wells and found 3 feet water. Kept the pumps going day and night. Vessel rolling very heavily.

Vessel's position at noon.

Latitude	15° 10′
Longitude	89° 12′
Barometer	29·75

Log of the 6th instant.

At 9 A.M. wind still increasing from north-east, with heavy seas coming on board. Lost fore-topsails. Vessel filling with water. Sounded wells, and having found four feet, kept men working at the pumps all the time; vessel still rolling heavily at 2 P.M. Barometer 29·29; vessel in latitude 14° 42′, longitude 89° 53′. Blowing a cyclone; had to cut away mast to prevent vessel from foundering. At 4 P.M. had also to throw part of the cargo overboard.

Log of the 7th instant.

At 1 A.M. wind south; weather moderating. Barometer 29·60. Began to get the vessel jury rigged.

The following is the account of the encounter of the Indian Government Transport Ship *Tenasserim* with the cyclone on the 5th and 6th instant.

The *Tenasserim* left Vizagapatam on the evening of Wednesday, 4th instant, with fine clear weather and a moderate sea. Wind north-east; weather rather hazy about the horizon. On the morning of Thursday, the 5th instant, sun rose in a dense hazy bank between 6 and 7 A.M.; observed small whirlwinds and waterspouts often, and moderate squall from south-east. Wind light and variable; heavy clouds to eastward; sea moderate. 8 A.M.—Clear, with detached light clouds; towards noon, heavy banks of clouds to eastward and north-east; ship's position by observations at noon latitude 16° 41′ north, longitude 85° 25′ east. 1 P.M.—Sharp squalls with heavy rain; sea rising fast and very irregular, but having a tendency to flow from the eastward; barometer 29·90; thermometer 86. Temperature of sea 76° F.; wind steady, north-east.

Hours.	Barometer.	Winds.	REMARKS.
P. M.			
1	29·90	N.E. by N.	*Thursday, 5th.*—After sunset sea very high, running from eastward; compelled to ease engines; wind steady, but frequent squalls.
2	·88	......	
3	·85	N.E.	
4	·84	......	
5	·82	......	11-30 A.M.—Barometer falling fast and wind veering to northward; put ship's head to southward. 2 P.M.—Steered to south-west; sea running very heavy and irregular.
6	·82	......	
7	·81	......	
8	·80	......	

Hours.	Barometer.	Winds.	Remarks.
P. M.			
9	·77	......	
10	·76	......	
11	·74	......	
12	·71	N.E. by N.	
A. M.			
1	29·64	N.N.E.	*Friday*, *6th*, 4 A.M.—Very violent squalls, with lightning and thunder; sea more regular; put ship's head round to follow sea till heading east, when we bore away; weather moderating; squalls less frequent and sea from the north-east still heavy. Sea continued heavy throughout the day, but more moderate towards sunset; clouds broken, and towards 10 P. M. stars and moon visible, with an occasional squall. *Saturday.*—Sea moderate; an occasional squall; broken detached clouds. Position by dead reckoning at 4 A.M.: latitude 15° N., longitude 86° 40′ E. Position by dead reckoning on Friday at noon: latitude 15° 11′ N., longitude 87° 35′ E.
2	·56	......	
3	·48	N. by E.	
4	·41	......	
5	·46	N.	
6	·48	N.N.W.	
7	·51	N.W.	
8	·54	N.W. by W.	
9	·50	......	
10	·52	W.	
12	·60	S.W.	

Log of the Ship "Tenasserim."

DATE.		TRUE SHIP'S HEAD	TRUE WIND.		B. T. BAROMETER, No. 203.		Clouds.	REMARKS.
YEAR 1876.		By same compass as wind; also true course and distance by log each 4 hours.	Direction.	Force. 0–12.	Height of cistern. Uncorrected reading.	12 feet. Attached thermometer.		
Month, Day. Civil time.	Hour.							
October 2nd ...	4 A.M.	N. 16° E.	Variation from S.W. to S.S.E.	3 to 4	29·992	82·4	Cumulus and Nimbus.	
	8 A.M.	......	N.W., W., S.S.W.	4	30·130	81·0	....	4 A.M.—Clouds crossing the moon from S.W., S., and N.W.
	NOON	86 miles	S. W. by S.	3	·050	82·2	....	
		POSITION AT NOON Lat. Obs.	0° 37′ N.	......		Long. Obs.	88° 43′ E.	
	4 P.M.	N. 23° E. 16′	S.S.W.	3	30·016	82·5	Cumulus and Nimbus.	9½ P.M.—Light squall from west.
	8 P.M.	14	......	3	·100	82·5	Cumulo-stratus and Nimbus.	Midnight.—Wind unsteady, banks of nimbus crossing from W. and N.W.
	MIDT.	25	S.W. to W.	3, 4, 5	·068	81·2	Cumulus and Nimbus.	
„ 3rd ...	4 A.M.	24	S.Westly.	5	·030	82·0	Ditto.	0 to 5 A.M.—Continual rain; sharp puffs at times from the west.
	8 A.M.	30	......	5	·094	81·2	Cumulo-stratus and Nimbus.	
	NOON	38	......	5	·080	82·0	Ditto.	
		POSITION AT NOON Lat. Obs.	3° 9′ N.	......		Long. Obs.	89° 40′ E.	P.M.—Westerly wind very unsteady. Temperature of falling rain 75½.
	4 P.M.	N. 1° W. 36′	S.Westly.	5, 6	29·990	82·3	Stratus and Nimbus.	
	8 P.M.	32	......	5	30·054	81·7	Ditto.	
	MIDT.	28	......	5	·050	82·0	Cumulus and Nimbus.	Midnight.—Fresh steady breeze.
„ 4th ...	4 A.M.	28	S. by W. to W.S.W.	5	29·968	81·7	Ditto.	A.M.—Breeze again squally and unsteady, with much rain.
	8 A.M.	34	S.W. & W.	6	30·040	82·8	Ditto.	
	NOON	38	S.W.	5	29·986	84·0	Ditto.	Noon.—Black clouds crossing the sun from N.W.
		POSITION AT NOON Lat. Obs.	6° 23′ N.	......		Long Obs.	90° 19′ E.	
	4 P.M.	N. 1° W. 36′	W.N.W.	6	29·950	83·0	Cumulo-stratus.	
	8 P.M.	N. 6° W. 32′	W.	5, 6	30·040	82·0	Cumulo-stratus and Nimbus.	Between 8 and 12 P.M. the sky was at times quite clear, and at others nearly overcast with clouds.
	MIDT.	36	......	5, 6, 7	29·984	81·5	Cumulus and Nimbus.	
„ 5th ...	4 A.M.	30	......	6	·950	82·0	Ditto.	0 to Noon.—Fresh winds and squally throughout; squalls gradually growing stronger, each squall a little heavier than its predecessor.
	8 A.M.	32	W. by S.	6, 7	·972	81·3	Ditto.	

	NOON	32	……	6, 7	30·064	82·8	Ditto.	At 1½ P.M. we had a very hard squall from W.N.W. with rain in torrents, and as there appeared to be bad weather to the northward of us we shortened sail for some hours.
		POSITION AT NOON Lat. Obs.	9° 42′ N.	……		Long. Obs.	90° 18′ E.	
	4 P.M.	N. 26° E. 12′ N. 7° W. 12′	S.W. to N.W.	6, 7, 8	29·894	81·2	Cumulus and Nimbus.	Midnight.—Ends with strong S.W. wind, heavy squalls, lightning and a threatening appearance in the N.W.
	8 P.M.	N. 7° W. 22′	W.	7, 8	·936	82·0	Ditto.	
	MIDT.	N. 14° W. 28′	S.W.	7	·946	82·5	Ditto.	
„ 6th …	4 A.M.	N. 12° W. 28′	S. W. to W.	6, 7, 8	29·864	82·0	Stratus and Nimbus.	A gale, with very heavy squalls and torrents of rain. This weather, &c., lasted until late in the afternoon, when it grew finer; but as the wind went down, the sea increased, and came rolling across from the N.W. in large waves, which, crossing the S.W. sea, made the ship very uneasy.
	8 A.M.	26	……	6, 7	30·000	82·5	Cumulus and Nimbus.	
	NOON	28	S.S.W.	7	29·900	83·5	Ditto.	
		POSITION AT NOON Lat. Obs.	11° 45′ N.	……		Long. Obs.	90° 21′ E.	
	4 P.M.	N. 12° W. 28′	S.S.W.	7	29·912	83·5	Cumulus and Nimbus.	At 7 P.M. several flashes of lightning showed in N.W.
	8 P.M.	28	S.W.	7	·972	84·0	Cumulo-stratus and Nimbus.	Midnight.—Fresh S.S.W. wind, with turbulent S.W. and N.W. swells, and small dark clouds crossing luna from eastward.
	MIDT.	24	S.S.W.	6	·908	83·3	Cumulo-stratus.	
„ 7th …	4 A.M.	28	S.S.W.	6	29·894	83·5	Ditto.	
	8 A.M.	22	S. by E.	5	·944	84·0	Cumulus and Nimbus.	Wind gradually decreasing throughout this day, but swell keeping up higher and higher, and running from W., N.W., S.W., and S.
	NOON	16	S. by E.	4	·950	85·4	Cumulo-stratus and Nimbus.	
		POSITION AT NOON Lat. Obs.	14° 8′ N.			Long. Obs.	90° 13′ E.	
	4 P.M.	N. 11° W. 18′	S.S.W.	4	29·860	86·3	Cumulo-stratus.	
	8 P.M.	N. 6° W. 14′	S. by E.	4, 3	·904	86·0	Ditto.	
	MIDT.	12	……	3	·934	85·8	Ditto.	
„ 8th …	4 A.M.	14	……	3	·846	84·9	Cumulus.	
	8 A.M.	14	……	3	·904	85·5	Cumulus and Cirrus.	Fine all this day; cross swell running west; much less of it than yesterday.
	NOON	19	……	3, 4	·868	86·0	Cumulus and Stratus.	
		POSITION AT NOON Lat. Obs.	16° 43′ N.			Long. Obs.	89° 56′ E.	
	4 P.M.	N. 6° W. 24′	S.	5	29·850	87·5	Cumulo-stratus.	
	8 P.M.	24	……	5	·930	87·0	Ditto.	Midnight.—Black clouds crossing luna from S.W.
	MIDT.	24	……	5	·858	86·0	Ditto.	
„ 9th …	4 A.M.	26	……	5	·840	85·0	Ditto.	
	8 A.M.	20	……	4	·864	84·0	Cumulus.	Moderate breezes all day, increasing towards evening. Many birds and butterflies about.
	NOON.	20	……	4	·850	87·5	Cumulo-stratus.	
		POSITION AT NOON Lat. Obs.	18° 55′ N.			Long. Obs.	89° 54′ E.	

Notes on a Cyclone experienced by the British India Steam Navigation Company's S.S. "Satara" in October 1876, bound from Calcutta to Port Blair.

LEFT Calcutta on the 4th October at 1-30 P.M. and anchored at Kulpee for the night. Light east winds and very fine weather. Barometer 29·70, thermometer 84°.

October 5th.—Weighed and proceeded at 8-40 A.M., with weather as above. Secured everything and prepared ship for sea. 4-30 P.M.—Discharged the pilot at the Sandheads and shipped a course for the bows, S.E. by S. true. Weather still very fine and light, but at sunset perceived a heavy arched bank of clouds to S.E. Had all the ports and scuttles well secured. From this to midnight moderate east winds and fine weather. Barometer 29·67, thermometer 85°.

October 6th.—Commenced with fine weather, but a rapidly increasing swell from S.E. 2 A.M. to 4 A.M.—Weather getting very dirty and wind increasing in squalls from east, with heavy rain; sea rising fast. Prepared ship for bad weather, furled all sails and awnings, rigged hatch tents, and prepared hatchways for battening down if necessary. Barometer 29·68, thermometer 84°. At 5 A.M., having come to the conclusion that I was on the northern verge of a cyclone, I kept her head up east to wind and sea. At 8 A.M. blowing a strong gale from east, with a tremendous confused sea; ship labouring very heavily and shipping much water on deck. Reduced speed to slow, which eased the vessel considerably. Barometer 29·67, thermometer 84°. 8 A.M. to 11 A.M.—Commenced with fine weather. 11 A.M.—Wind moderating and veering gradually to the southward; weather showing signs of improvement; increased speed and kept her head to wind. Noon.—Moderate gale, with hard squalls and very high sea; ship labouring heavily. Latitude by dead reckoning 19°40′ N., longitude by dead reckoning 89°39′ E.; course made from Eastern Channel Light-vessel S. 46° E., 114 miles. Barometer 29·63, thermometer 82°. 4 P.M.—Moderate E.S.E. gale, with very high sea and fine cloudy sky. Barometer 29·60, thermometer 83°. 6 P.M.—Decreasing wind and fine; kept the ship on her course for the bows again. 8 P.M.—Strong south-east winds with very high sea, fine sky, moon and stars clear and bright, but scuds flying very fast to north-west; ship labouring heavily. Barometer 29·64, thermometer 84°. Midnight.—Strong S.E. by S. winds, with fine cloudy sky and very heavy sea running.

October 7th, 8 A.M.—Fresh S.E. by S. winds and fine clear sky with heavy sea. Considering the cyclone to have now passed to the westward, I removed hatch-tents and rigged windsails and ventilators, and allowed the passengers and convicts to be brought on deck. I increased to full speed. Noon.—Fresh south-east winds with very high south sea; fine weather with occasional squalls; ship labouring heavily. Barometer 29·60, thermometer 85°. Noon.—Latitude by observations 18°33′ N., by dead reckoning 18°20′ N.; longitude by observations 90°54′ E., by dead reckoning 90°59′ E., S.E., 215 miles from Eastern Channel Light-vessel. Current had set N. 18° W., 14 miles. 4 P.M.—Fresh breeze, veered to south, fine weather and high sea. 8 P.M.—Wind S. by E., veered to south; fine weather and high sea. Midnight.—Wind S. by E., veered to south; fine weather and high sea.

October 8th, 6 A.M.—Heavy banks of cloud with threatening appearance to south-east and south-west. 8 A.M.—Moderate south wind and fine hazy weather with very heavy sea; ship labouring heavily; set fore and aft sail to steady her. Barometer 29·64, thermometer 83°. Noon.—Wind veered to S.S.W., moderate and fine, with heavy sea. Barometer 29·60, thermometer 84°. Latitude by observations 15°49′ N., by dead reckoning 15°55′ N.; longitude by observations 92°34′ E., by dead reckoning 92°25′ E. Current set S. 57° E., 11 miles; Coco light bore S. 25° E., 107 miles. 4 P.M.—Wind veered to south-west; fine; all sail set; sea moderating. 8 P.M.—Fresh south-west winds and cloudy weather. 11 P.M.—Passed to the eastward of the Cocos (current since noon S. 78° E., 14 miles) and hence to Port Blair; experienced strong S. W. winds and hard squalls with much rain, arriving at 5. P.M. on the 9th.

The S. S. *Satara* sustained no damage whatever.

The following are the barometer readings for this period, which gave no indication of the storm :—

Date.	Hour.	Barometer.	Aneroid.	Sympiesometer.	Thermometer.	Wind.	Force.
		Inches.	Inches.	Inches.	⦶		
October 4th	12 P.M.	29 70	......	......	85	Easterly.	2
„ 5th	12 A.M.	·70	......	......	85	Ditto.	3
„ 5th	6 P.M.	·65	......	......	84	S. Easterly.	1
„ 5th	12 „	·67	......	......	85	East.	3
„ 6th	4 A.M.	·65	29·52	29·35	84	E. S. E.	6
„ 6th	8 „	·67	·57	·38	84	East.	10
„ 6th	Noon.	·63	·53	·36	82	E. S. E.	8
„ 6th	4 P.M.	·60	·48	·20	83	Ditto.	7
„ 6th	8 „	64	·53	·25	84	S. E.	6
„ 6th	12 „	·63	·50	·30	84	S. E. by S.	6
„ 7th	2 A.M.	·60	·48	·25	84	S. S. E.	6
„ 7th	6 „	·64	·52	·30	83	Ditto.	5
„ 7th	8 „	·67	·55	·28	84	S. E. by S.	5
„ 7th	Noon.	·60	·48	·12	85	Ditto.	5
„ 7th	4 P.M.	·58	·47	·15	85	S. by E.	5
„ 7th	8 „	·63	·53	·25	85	Ditto.	5
„ 7th	12 „	·65	......	......	84	Ditto.	5
„ 8th	4 A.M.	·60	·50	·23	83	South.	4
„ 8th	8 „	·64	·55	......	83	Ditto.	4
„ 8th	Noon.	·60	·52	·25	84	S. S. W.	3
„ 8th	4 P.M.	·55	·45	·20	84	S. W.	4
„ 8th	8 „	·62	·52	·25	84	Ditto.	5
„ 8th	12 „	·61	......	......	83	Ditto.	5
„ 9th	8 A.M.	·70	·58	·40	81	Ditto.	5-6
„ 9th	Noon.	·63	·54	·35	83	Ditto.	5
„ 9th	4 P.M.	·69	......	......	......	West.	4

Abstract of Diary kept by J. H. Atkinson, *Commanding British India Steam Navigation Company's S.S. "Ethiopia" on a voyage from Calcutta towards Bombay viâ coast ports.*

Date.	Hour.	Barometer.	Thermometer.	Wind.	Position of ship.	Remarks.
October 5th 1876, Thursday ...	10 A.M.	30 020	88	......	Calcutta	
	4 P.M.	29·910	89			
Friday, 6th ...	10 A.M.	30·020	83	S. E.	Fisherman's Point.	
	4 P.M.	29·912	79	S. S. W. to N. E.	Kedgeree anchor... ...	Weather gloomy; rain at times; heavy clouds to S.E.; at 10 P.M. wind N.E. with rain; very gloomy appearance to eastward.
	10 „	·964	81			
Saturday, 7th..	4 A.M.	·860	80	N. E.	Ditto ditto ...	Fresh breeze and cloudy.
	10 „	·936	80	E.	Proceeding down river ...	Heavy rain.
	4 P.M.	·810	82	S. S. E.	Near Eastern Channel Light-vessel.	Very heavy sea from southward, squalls and rain.
	6 „	·776	82	......	S. S. W. of light-vessel 7m.	Ditto ditto ditto.
	10 „	·814	83	S. E.	Steering towards False Point south of Pilot Ridge.	Moderate breeze with heavy swell from southward, shipping much water fore and aft.
Sunday, 8th ...	4 A.M.	·700	83	S. E.	Waiting daylight off False Point.	Wind fresh, heavy swell from S.E.
	10 „	·800	83	S. E.	At False Point anchor...	6-35 A.M.—Anchored at False Point; strong wind and much sea; able to work cargo during flood-tide, which gave a lee to boats. Swung in all boats and secured everything about decks.
	3 P.M.	·700	85	S. E.	....	
	5 „	·724	85	S. S. E	....	
	10 „	·750	84	S. E.	....	Wind strong and clear weather; decided on remaining at anchor till daylight to see what the weather means.
Monday, 9th...	1-30 A.M.	·650	84	S. E.	....	Fresh S.E. gale; got up steam.
	5-30 „	·640	84	......	....	Ditto ditto; hard squalls and rain.
	10 „	·680	83	......	....	Ditto ditto; squalls very heavy.
	Noon.	·674	83	S. E. by S.	....	Ditto ditto ditto ditto.
	1 P.M.	·636	83	S. S. E.	....	Heavy gale.
	2 „	·620	83	S. by E.	....	Ditto, with heavy bank of dull leaden clouds S.W. to N.W. about 10° high, above the broken clouds.
	3 „	·610	83	S. by E., calm.	....	Wind falling to calm after heavy rain; a sudden shift to S.S.W., with heavy gusts; back to south after squalls.
	4 „	·600	83	S.	....	
	5 „	·600	83	......	....	Heavy squalls; weather broken; sun showing through gap in heavy to westward.
	6 „	·590	83			
	7 „	·650	83½	S. S. W.	....	Squalls and rain.
	8 „	·680	83½	S. by W.	....	Wind unsteady with rain; stars overhead and through breaks in cloud low down; lightning S.W. and northward.
	10 „	·724	84	S.		
Tuesday, 10th	3 A.M.	·700	84	S. S. W. & S. W.	....	Drizzling rain.
	5 „	·650	82			
	......	......	......	......	....	6 A.M.—Weighed and proceeded to sea towards Gopaulpore.
	8 A.M.	·736	83	S. S. W.	Off False Point Light-House.	Weather fine, with rain squalls at times; winds light. Heavy southerly swell and confused sea; ship rolling about and shipping much water; *standard barometer broken by heavy lurching of ship about noon; after noon readings of aneroid, which usually shows* ·10 *below standard.*
	Noon.	Aneroid 29·75	82	S. S. W. and S. W.	Latitude 19° 1/8′ N. ... Longitude 86° 35′ E.	
	4 P.M.	·68	82	......		
	6 „	Sea going down rapidly.				

Abstract of Diary kept by J. H. ATKINSON, *Commanding British India Steam Navigation Company's S.S.* "*Ethiopia*" *on a voyage from Calcutta towards Bombay viâ coast ports*—(Contd.).

Date.	Hour.	Barometer.	Thermometer.	Wind.	Position of ship.	REMARKS.
Wednesday, 11th ...	......	......	......	......	....	At daylight found ship set 25 miles south of Gopaulpore; strong current to southward about 30 miles off land; heavy swell from S.E. About 1½ miles south of Sonepore observed a large spire buoy painted red and white stripes (horizontal); a basket on spire.
	10 A.M.	29·90	82	Calm.	... .	
	Noon.	......	......	......	Anchored off Gopaulpore.	
	4 P.M.	·80	84	S. E, wind light	....	

The following valuable and complete series of observations were taken at the private observatory of Mr. A. V. Nursing Row, Vizagapatam, before and during this cyclone, and give a complete history of the cyclone as experienced at that station.

No. 1.—*The Statement of Observations taken at Vizagapatam before and during the Cyclone.*

Date.	Hour.	Barometer reduced to 32°.	Dry bulb.	Wet bulb.	Humidity.	Direction of wind.	Velocity of wind.	Serenity.	Rain.	General weather.
5th October 1876.	4 h.	29·753	83	78·5	81	N. W.	·80	20	......	Round by S.
	10 h.	29·817	86	77·8	68	W. S. W.	2·80	50	......	
	16 h.	29·729	86	77·8	68	E.	36·15	30	......	
	22 h.	29·801	84·7	76·5	68	E. N. E.	28·54	20	......	From 8 to 10½ P.M. a large halo was seen round the moon, it was greasy. Fleecy clouds, points up.
6th October 1876.	4 h.	29·715	83·8	75·2	64	W. N. W.	5·51	60	......	
	10 h.	29·778	84·8	79·2	75	N. N. W.	13·80	......	......	Clouds nimbus. Masses of clouds passing from west to east.
	16 h.	29·622	85·6	74	54	N.	24·80	......	......	
	22 h.	29·644	83	74·8	67	N.	38·80	......	·1	
7th October 1876.	4 A.M.	29·509	80·6	73·8	70	N.	57·01	......	·3	
	7½ „	29·509	80·8	73·8	70	N.	......	......	......	
	8 „	29·499	81	73·6	70	N.	......	......	......	Ditto ditto forming banks of clouds north-east.
	9 „	29·497	81·5	73·6	66	W. N. W.	......	......	......	
	10 „	29·497	82	73·5	65	W. by N.	73·99	......	·1	
	11 „	29·497	81·5	73·5	66	N.	......	......	......	
	11¾ „	29·434	81	73·7	70	N.	......	......	......	
	1 P.M.	29·393	80·6	74	70	N.	......	......	......	
	2 „	29·342	80·4	74	74	N.	......	......	......	
	3 „	29·324	80	74	74	N.	......	......	......	
	4 „	29·286	79·8	74	74	N. W.	193·80	......	·8	Storm commenced.
	5 „	29·242	80·5	74·2	74	N. W.	......	......	......	Lulls at short intervals not exceeding 4 or 5 minutes. Squalls attended with rain. Each recurrence with greater violence.
	6 „	29·[illegible]36	79·4	74·3	77	N. W.	......	......	......	
	7 „	29·236	79·4	74·4	77	N. W.	......	......	......	
	8 „	29·223	79	74	77	N. W.	......	......	......	
	9 „	29·201	79	74	77	N. W.	......	......	......	
	10 „	29 097	78·6	74	77	N. W.	237·30	......	4·4	
	11 „	29·083	78·6	74	77	N. W.	......	......	......	
	12 „	28·981	78·5	74·5	82	N. W.	......	......	......	

No. 1.—*The Statement of Observations taken at Vizagapatam before and during the Cyclone*—(Continued).

Date.	Hour.	Barometer reduced to 32°.	Dry bulb.	Wet bulb.	Humidity.	Direction of wind.	Velocity of wind.	Serenity.	Rain.	General weather.
8th October 1876.	1 A.M.	28·834	77·8	74	81	N. W.	......	......	......	
	2 „	28·834	77·8	74	81	N. W.	......	......	......	Intensity of the storm.
	3 „	28·832	77·7	73·8	81	N. W.	......	......	......	
	4 „	28·895	77·5	74	84	W.	357·40	......	5·2	Inundation as explained in the report; wind commenced to abate.
	5 „	28·949	76	73·5	88	W.	......	......	......	
	6 „	29·014	76·5	73·5	86	W.	......	......	......	
	7 „	29·061	75·6	73	86	W.	......	......	......	
	8 „	29·091	75·8	73	86	W.	......	......	......	
	9 „	29·175	76	73	86	W.	......	......	......	Wind dropped to a calm.
	10 „	29·252	76·8	73·6	86	W.	......	.....	5·6	Two hemispheres of the anemometer were blown off between 4 and 5 A.M. Velocity therefore not registered.
	11 „	29·267	76·6	73·6	86	W.	......	......	......	
	12 „	29·276	77	74	86	W.	......	......	......	
	1 P.M.	29·292	77	74	86	W.	......	......	......	
	2 „	29·310	77·6	74·6	86	W.	......	......	......	Floods commenced to subside.
	3 „	29·330	78	74·5	84	W.	......	......	......	Dense clouds commenced to clear up.
	4 „	29·354	77·9	74	81	S. W.	......	......	1·6	
	5 „	29·366	77·9	74·2	81	S. W.	......	......	......	
	6 „	29·377	78	74·6	86	W.	......	......	......	
	7 „	29·393	78	74·5	84	W.	......	......	......	
	8 „	29·441	78	75	86	S. W.	......	......	......	
	9 „	29·447	78	75	86	W.	......	......	......	
	10 „	29·449	78·3	75	86	S. W.	......	......	·2	
9th October 1876.	4 A.M.	29·478	79·5	73	72	W.	......	2·0	......	

The barometric height at Vizagapatam, as shown by the observations of the 4th and 5th, was falling, and was slightly lower than at other parts of the coast. The pressure began to fall rapidly from 4 P.M. of the 6th. During the remainder of the day and the morning of the 7th, the rapid motion of clouds from west to east indicated a strong set of the upper strata towards the region of atmospheric disturbance in the Bay. The lower atmospheric current on the 6th was from the north, but its velocity was very slight, averaging from three to six miles per hour. Above, the clouds indicated a direct indraught of the atmospheric current to the area of disturbance. The clouds which thus drifted over from west to east on the afternoon of the 6th and morning of the 7th formed large banks of clouds towards the north-east, apparently feeding the northern quadrant of the cyclone.

At 4 P.M., October 7th, the barometer had fallen to 29·256. A slight rainfall had occurred at intervals on the 6th and 7th, and the wind had gradually increased in velocity and intensity. The violence of the storm, the cyclone proper, burst over the town about 4 P.M., when severe squalls followed by short lulls lasting from three to five minutes began, and gradually increased in intensity. A succession of these squalls, accompanied by almost continuous and heavy rainfall from the north-west, continued for several hours. The mean velocity of the wind increased until it reached a maximum of nearly sixty miles per hour, and the barometer continued to fall until 3 A.M. of the 8th, when the reading (corrected) was 28·822. The storm was most severe between 2 A.M. and 3 A.M., after which the barometer began to rise, the wind veering round from north-west to west and south-west, thus showing that the southern quadrant of the cyclone was passing over the station. The excessive rainfall and violent wind continued until 9 A.M., when the wind dropped almost to a calm for a few minutes. The cyclone had now fairly passed away, and the dark clouds dispersed during the course of the afternoon. The barometer rose slowly and did not attain its normal height until the 10th.

The vortex from these observations and statements, it is evident, did not pass over Vizagapatam. The southern quadrant of the cyclone passed over it, but from the great and rapid fall of the barometer the vortex was at no great distance. Mr. Nursing Row's observations are the only accurate meteorological observations taken in the land area visited by the cyclone. Major Herbert Wood states, as a report, that during the middle of the storm perfect calm prevailed for a short period at Bimlipatam, a town on the coast about 13 miles to the north of Vizagapatam. It may therefore be assumed that the storm struck the coast at Bimlipatam, as this is in perfect accordance with the Vizagapatam observations. The greatest intensity of the storm was experienced at Vizagapatam between 2 A.M. and 3 A.M. This was probably the time when the centre was passing over Bimlipatam.

An officer writing from Vizianagram of the cyclone states that the wind in the early part of the storm was from north and north-east, and that perfect calm prevailed there for about half an hour from 9 A.M., after which the wind returned with even greater violence than before, but from the opposite quarter. The complete and sudden reversal of the wind direction from north-east to south-west and the period of calm are sufficient proofs that the same vortex, or a vortex produced by the same atmospheric disturbance, passed over Vizianagram six hours after it had passed over Bimlipatam. The distance between the two towns is only 18 miles, so that the cyclone travelled in a northerly direction from Bimlipatam at a rate of three miles per hour. The storm continued at Vizianagram until 4 P.M., or for seven hours after the central calm had passed. This agrees almost exactly with the interval between the greatest intensity of the storm and its conclusion at Vizagapatam.

Judging roughly from the interval of calm, the diameter of the central area must have been little more than a mile. The cyclonic area of disturbance was not more than 50 miles in width. The Ghâts, which are here almost at right angles to its course, seem to have been a perfect barrier to the westerly advance of the storm. It was deflected almost due north from Bimlipatam, rapidly diminishing in intensity, due to the influence of the hills in breaking it up, and passed over Vizianagram, where, although it was violent, yet, as Major Wood states, the trees there were scarcely injured.

The strength of the gusts of wind during the intensity of the storm may be judged from the fact that an iron dome for the astronomical observatory at Vizagapatam, which had arrived from England a short time previously and been placed in position, was lifted up and carried a distance of 33 feet. The screw had not been fastened down to the iron rings set in the stone walls, from the belief that such a mass as an iron dome, measuring 12 feet by 12 with corrugated iron walls nine feet high, could not be disturbed by the wind. Strange to say, it came down gently and settled quietly on the ground, and was not injured by its fall.

The rainfall at Vizagapatam during the storm was very great. From 4 P.M. to 10 P.M. of the 7th 4·4 inches fell, from 10 P.M. to 4 P.M. of the 8th 5·2 inches, and from 4 A.M. to 10 A.M 5·6 inches—a total of 15·2 inches in 18 hours. The total quantity of rain recorded during the storm was 17·6 inches. 15·6 inches fell at Vizianagram. The excessive rainfall seems to have taken place almost entirely on the southern and eastern quadrants of the cyclone. Major Wood states that the greatest rainfall must have taken place between Vizagapatam and Bimlipatam, for all the damage of any consequence that was done to roads and bridges took place between these towns and 20 miles westwards. The excessive rainfall produced a rapid rise in the rivers, whilst the flood water was prevented running off partly by the high tide and partly by the rise due to the diminished atmospheric pressure in the centre of the storm. At Santapilly, about 12 miles north of Bimlipatam, the French ship *Jules Rose* was driven ashore a total wreck. The Santapilly reef is usually just visible above sea-level. The Captain states that he experienced a strong westerly current which, in conjunction with the easterly gale, drove his ship right over the Santapilly reef, knocking out the bottom of his vessel. This evidence thus confirms the existence of the storm-wave advancing westwards. The storm-wave and the arrested flood-water not only accumulated over the swamp to the south-west of the town of Vizagapatam to a height of 8 feet above the ordinary level, but also inundated the western part of the town. The people were not prepared for it; about six hundred thatch-roofed houses were destroyed, and upwards of thirty dead bodies were recovered afterwards.

At Chicacole, 13 miles to the north of Bimlipatam, the centre arches of the large bridge were carried away. The river here rose on the night of the 8th to the height of over 20 feet, a height which it has never attained in the memory of man. It flooded almost the whole station of Chicacole, destroying nearly three-fourths of the houses of the villages of Balaga, Bouthelapooram, Illispooram, and Patha Chicacoli. Between 11 and 12 P.M. a report was heard like the discharge of cannon. This was due to the bursting of the arches of the bridge. Before this there had been a great accumulation of trees and the *debris* of villages on the upper face which completely choked up the arches. The strong wind blowing up the river tended to arrest its waters, whilst finally a high wave rushed up the river. The rapid increase of the water, due to the combination of these causes, was too great a test for the strength of the bridge. The flood at Chicacole, if the dates given are correct, was an after effect due to the great accumulation of flood waters and the tidal action at the following high tide.

The water action during the storm in scouring and denuding the coast was strikingly shown at Vizagapatam. Before the cyclone there was in the channel over the bar at high water six feet, and at low water three feet; it is now nine feet nine inches deep at high water, and six feet nine inches at low water. A shoal opposite the commercial shed, which was formerly high and dry, has now a depth of 14 feet of water on it at low water.

Such is the whole of the information that I have been able to obtain of this part of the cyclone from the logs of vessels and from the district over which it passed.

CHAPTER II.

Meteorology of Bengal during the period preceding the Vizagapatam Cyclone, and the origin and path of the Cyclone.

THE observations which are at present at my disposal for the discussion of the origin and path are only those for a portion of India, viz. Bengal, Behar, Assam, and the North-Western Provinces, together with a few stations in Southern India, of which the most important are Madras and Vizagapatam, and are given in full in the preceding section. The logs of the vessels which have reached me give necessarily an extremely imperfect and inadequate view of the meteorology of the Bay of Bengal itself. This region, which is a small arm of the Indian Ocean, may be taken as the water area north of a line drawn across from the south of Ceylon to the north coast of Sumatra above the fifth parallel of latitude. It includes an area of nearly one million square miles, an extent slightly less than the whole of India. Our knowledge of the meteorology of this vast area during the month of October is limited to the brief extracts from two dozen vessels traversing it along a few lines of navigation. The area is so large that cyclones may rage for some time and even break up without giving any warning on shore, and without even encountering a single vessel. The vastness of the area and the scantiness of the information necessarily prevent the meteorologist from giving precise details of the passage of cyclones at sea.

The rains in 1876 were plentiful in quantity and normally distributed over the whole of Bengal, Behar, and Assam. They commenced in the second week of June along the Arracan coast and passed upwards as far as Behar by the third week of the month. Further west rain did not fall in abundance until the middle of July. The mean distribution of pressure over Northern India and the head of the Bay of Bengal before the rains did not differ much from the average, but yet sufficiently to account for the partial withholding of the rains in Upper India. The pressure decreased more rapidly than usual in the lower part of the valley. The barometric difference at this time between Calcutta and Patna was ·07″, and between Patna and Roorkee only ·01″. The province of Behar and the neighbouring districts thus formed an area of relatively low pressure. The pressure in Bengal and the head of the Bay and also in the Punjab was normal in its amount.

This diminished air pressure over Behar, which continued in a concentrated form during the month of July, and the partial failure of the direct south-west monsoon, explain the scanty rainfall in the North-Western Provinces, more specially in the western-half, during the early part of the south-west monsoon season. In June there was a very marked tendency to a cyclonic movement of the winds around this area of low pressure, the mean wind direction at Allahabad and Benares being N. W., at Hazaribagh W.N.W., at Gya S.E., and at Goalpara and Purneah E.N.E. The barometric differences between the head of the Bay and the southern and south-eastern portion of it were slightly greater than usual during the month of July. Thus the mean pressure at Port Blair was ·015″ above the average, whilst at Saugor Island it was ·03″ below the mean, so that the monsoon current up the Bay was due to a mean baric difference of ·35″ during the month instead of ·3″. The area of low pressure during the month extended from Benares to Patna, and was nearly coincident with the area of low pressure of the previous month. The pressure over the western half of the North-Western Provinces was slightly above the average. The distribution of pressure was thus similar to that of the preceding month. The rainfall was directly dependent on this distribution of pressure, as it fell in abundance in Bengal and Behar, whilst in the North-Western Provinces it was considerably below the average.

During the month of August the distribution of pressure over the Bay and Northern India was much more uniform than in July, and nearly approached the mean distribution as obtained from the observations of the last seven years. The pressure at Port Blair and Madras was almost identical with the mean. In the North-Western Provinces and the Punjab it was very slightly (·01″) above the mean. The winds were south-west in the Bay, south-east at the head of the Bay, and east over the whole of the Gangetic plain, and thus were quite normal in their general character.

The general distribution of pressure in September was also fairly regular. The chief features in it were increased pressure over the whole of the Bay and over Northern India. The increase was, however, greatest in the south of the Bay. Thus at Port Blair the pressure was ·04″ above the average and at Madras ·03″, whilst at Saugor Island it was only ·02″, at Patna 01″, and at Roorkee ·025″. The moisture current from the Bay gave abundant supply of rain to Bengal and Behar, where the pressure was relatively low both to the North-Western Provinces and to the Bay. Such was the general distribution of pressure in its relation to rainfall during the greater part of the south-west monsoon of 1876.

In connection with the rainfall during the last fortnight of September, the following principle may be mentioned. During the rains the barometric differences between the south and the head of the Bay are in a state of constant fluctuation, marked oscillations of periods varying from three or four days to a fortnight following each other. When the baric differences are considerably in excess of the normal difference heavy rainfall commences along the coast, beginning from Akyab and spreading rapidly northwards and westwards, and continues so long as the baric differences remain high and above the average.

The following table gives the baric differences between Saugor Island on the one hand, and Port Blair, Nancowry, and Madras on the other during the last week of September :—

Normal.	Saugor Island to Port Blair.	Saugor Island to Nancowry.	Saugor Island to Madras.
	·076	·120	·071
17	.069	·103	.034
18	.062	·098	.038
19	.084	·101	.052
20	·078	·099	·054
21	·118	·160	·083
22	·137	·161	·111
23	·111	·139	·108
24	·076	·100	·088
25	·075	·071	·057
26	·036	·061	·051
27	·042	·069	·024
28	·025	·032	—.023
29	·004	·008	—.049
30	·030	·038	·005

This table shows that the baric differences were less than the normal amount at the middle of the month, a period of slight rainfall in Bengal and of fine weather in the North-Western Provinces. The baric differences gradually increased and were above the average on the 19th. They attained their maximum on the 22nd and continued above the average until the 24th. On referring to the table of rainfall, it will be seen that this was a period of heavy rainfall along the Arracan coast and Bengal, whilst, on the other hand, the last five days were marked by an absence of rain, except in the form of light showers over limited areas. Amongst the heavy falls of rain noted during this period of increased baric difference between the Bay of Bengal and the coast region are the following:—

STATIONS.	21st.	22nd.	23rd.	24th.	25th.
Akyab	......	3·03	3·99	1·03	......
Noakholly	3·50	......	2·25	......	......
Patuakhally (Backergunge)	......	3·67	2·15	......	......
Cheerapoonjee	2·27	3·28	3·20	3·52	......
Hazaribagh	......	......	1·41	......	......
Gya	......	......	3·77	......	......
Patna	......	3·16	......	......	......
Dinapore	1·30	2·75	......	......	......
Mozufferpore	1·52	1·09	10·76	......	......
Julpigoree	4·29	2·02	......	2·60	2·45
Dinagepore	......	2·63	......	2·27	......

The pressure at the end of September and the beginning of October over the whole of Northern India usually presents very slight differences, except in case of abnormal atmospheric disturbance. The mean pressure at Port Blair is at this period 29·83", whilst at the mouth of the Ganges and over the whole of the Gangetic valley it varies by very small amounts, from 29·9". It approaches more nearly to a state of relative equilibrium than at any other season of the year. The south-west monsoon is then gradually retreating southwards down the eastern side of the Bay, whilst over the western coast calms and variable winds prevail, which precede the setting in of the north-east monsoon in its full strength.

October 1st.—The chart for this day shows the distribution of pressure on the 1st of October. There was a region of low pressure over the Deltaic area, whilst the pressure in the south of the Bay was somewhat in excess. Over the whole of Northern India the differences of pressure were very slight. There was a very marked tendency of the winds towards the delta of the Ganges: indicating an indraught to the region of low pressure. In Northern India the winds were easterly along the Himalayas and westerly further south. In the south of the Bay the winds were westerly, the weather was cloudy, and 2·85 inches of rain fell at Port Blair and 1·79 inches at Nancowry. Local showers of no great amount occurred in various parts of Bengal. The velocity of the indraught to the area of low pressure over the Delta was, as shown by the returns of wind velocity, considerable. In the southern part of the Bay and in Upper India the winds were moderate.

The charts for the period October 1st to the 10th are given in Plate I.

October 2nd.—The effect of the wind distribution on the previous day had tended to equalize the pressure over the whole of Northern India and the Bay. The pressure at Allahabad (reduced to sea-level) was 29·849″, at Calcutta 29·822″, at False Point 29·827″, at Akyab 29·880″, at Vizagapatam 29·836″, and at Madras 29·865.″ The differences were thus inconsiderable. The pressure in the Bay was still lowest in the north-western angle. The region of relatively low pressure had advanced some little distance south, and now included the head of the Bay. The baric difference between the centre of this area and Port Blair was ·06.″ The wind velocity had decreased very considerably over the whole of Northern India, except in the Assam valley. In the Gangetic valley from Berhampore upwards the average velocity was in the lower portion only one mile per hour, and in the upper portion from two to three miles. The wind directions in the eastern portion of the Gangetic plain and around the coast line of the head of the Bay still showed a determination of the air to the region of low pressure at the mouth of the Ganges. Elsewhere the winds in Northern India seem to have been local rather than general, and indicate no considerable interchange between the land and sea. In the upper portion of the Gangetic valley there was an increasing tendency of the wind towards the normal cold-weather direction, north-west and west. The *Tenasserim* crossing the Equator on this day experienced cloudy weather and moderate winds from south-west; a squall from the west passed the vessel in the evening. Rainy weather still prevailed over the south-east portion of the Bay, as shown by the Port Blair and Nancowry registers; at the former station 1·41 inches were recorded. In Ceylon the wind was from the south-west, blowing a gentle breeze at the coast stations. Slight showers occurred in the interior. The rainfall was thus nowhere excessive at this time.

October 3rd.—The baric lines in the chart for the day show the almost completed result of the local winds of the preceding two days. The pressures around the coast of the Bay had become uniform, the area of low pressure having disappeared. The pressure (reduced to sea-level) at Port Blair was 29·865, at Madras 29·871, at Akyab 29·870, at Saugor Island 29·865, at Chittagong 29·881, at Patna 29·889, and at Allahabad 29·888. The baric differences between stations along the coast of the Bay of Bengal and in the Andamans and Nicobars were now extremely slight. The pressure was rising in Upper India, indicating a marked tendency to the setting in of the north-east monsoon. One result of this equalization of pressure in Bengal and over the Bay was a reduction of the velocity of the wind, and a gradual change of the wind direction from convergency to the area of depression at the mouth of the Ganges to a general circulation round the coast. There was most probably at this time no barometric depression in the middle of the Bay, judging from the disposition of the winds around the coast on this day. With the increase of pressure in the north-west, there was an increased motion of the atmosphere down the upper part of the Gangetic valley. The velocity was, however, everywhere slight, not exceeding an average of from two to four miles an hour. The wind velocity in the south of the Bay was somewhat greater. Here, in latitude 3°, longitude 89°40′, the *Tenasserim* had continued rain with occasional sharp puffs from the west. This apparently indicates the setting in of the saturated south-westerly, or west-south-westerly, current which precedes the immediate formation of a cyclone. On this day the rainfall at Nancowry was 1·53″ and at Port Blair only ·04″. There was a local rainfall over the area including the Dacca and Jessore districts, probably due to the influx of air and vapour during the previous two days into the area of depression, which was now rapidly disappearing. The atmospheric pressure in Ceylon was on this day, as on the previous two days, slightly in excess. Moderate south-westerly winds prevailed during the day. The rainfall was very slight.

October 4th.—The distribution of pressure around the coast of the Bay was generally similar to that of the preceding day. The barometer had risen very slightly at the north-western angle of the Bay, and had fallen over Northern India. Over the whole of this region the amount of its variation was only ·04″. The barometer had fallen considerably at Port Blair and Nancowry, where the barometric oscillations are usually confined within very narrow limits. The amount of the fall in Ceylon was only ·015.″ The distribution of the isobaric lines, so far as they can be filled in from the returns, suggests that on this day the formation of a region of low pressure began to the west or north-west of the Andaman Islands. The movement of the atmosphere was very nearly identical with that of the 3rd. In the upper part of the Gangetic valley the winds had now become westerly, whilst the distribution of the winds around the Bay continued to indicate a general cyclonic motion. The frequent changes of the wind at Port Blair support this view. There is, however, no evidence on this day of the existence of any centripetal tendency of the winds in the districts more remote from the centre of the Bay. The *Tenasserim*, which on this day at noon was in latitude 6°23′N. and longitude 90°19′E., reports cloudy squally weather, the wind being from the south-west and west and accompanied with rain.

The rainfall at Nancowry during the day was 1·96″, and at Port Blair 2·27″. Over the whole of Northern India the rains had ceased, and fine calm unclouded weather prevailed from the 2nd until the cyclonic vortices formed during the next two days had advanced sufficiently near to the coast to produce rain over the area of disturbance. The log of the *Tenasserim* states that black clouds were crossing the sun from the north-west. These clouds were probably at no great height, and seem to indicate the existence of the current completing the general rotatory motion of the atmosphere round the limits of the Bay. The log of the *Tenasserim* and the Nancowry anemometric and rain returns show that the velocity of the westerly saturated current in the southern and eastern portion of the Bay was increasing in strength and was attended with almost continuous precipitation. The wind velocity at the Ceylon stations was slightly greater on this day than on the previous. The rainfall was not great, the only station which had heavy rainfall being Colombo, where 4·10 inches were registered.

October 5th.—The distribution of the mean pressure was similar to that of the preceding day. The baric differences round the coast were still small, the pressure varying in amount from 29·84 to 29·87. It was lowest along the coast in the neighbourhood of Vizagapatam. The barometric depression in this case was, however, so slight as to give no indication of the approach of the cyclone in the absence of knowledge of its formation in the centre of the Bay. The pressure was even more uniform in the Gangetic valley than round the coast. In the upper part, at Roorkee and Bareilly, there was no perceptive motion of the air. The pressure at Port Blair and Nancowry had risen from the previous day, and was now at the same height at Nancowry as on the 2nd. At Port Blair it was ·04″ lower than what it was on the first three days of the month. The pressure at the Ceylon stations was almost the same as on the previous day. The wind directions presented, with one exception, the same features as on the previous day, viz. a cyclonic movement round the whole coast and limits of the Bay, together with a slow atmospheric motion down the Gangetic and Assam valleys. A Port Blair the wind, which had been north and west on the previous day, was now south-west. This indicates that the vortex which had, as will be presently shown, been formed to the north-west of the Andamans was, under the pressure of the increasing south-west wind current, retreating to the north-west. In Ceylon the winds, more especially in the south of the island, were more variable than on the previous day. The wind velocity, except at the northern stations (the wind returns of which seem to me to be of doubtful value), had diminished during the preceding 24 hours, and the atmospheric current was very little stronger here than in Upper India.

The ship *Tenasserim*, which at noon was in latitude 9°42′N. and longitude 90°18′E., met with fresh squally winds during the morning, which gradually increased in strength during the day, the wind becoming more westerly as she advanced north ; at 1-30 P.M. she met with a very hard squall from the west-north-west, during which rain fell in torrents. This is significant, as showing the tendency to the formation of a cyclone to the north-east of the vessel. After this the wind returned to its original direction, south-west, and was accompanied with heavy squalls and lightning. At Nancowry the sky was overcast, and passing showers gave a rainfall of 1·00″. At Port Blair 1·45″ fell, chiefly in the form of drizzling rain. The logs of the vessels *Anne* on her way from Muscat to Calcutta, the *Fuzzel Kurreem,* and the steamers *Tenasserim* and *Satara,* throw some light on the meteorology of the centre and north-western portion of the Bay. The *Fuzzel Kurreem* at noon of the 5th was in latitude 15°10′N. and longitude 89°12′E., or about 320 miles to the north-west of Port Blair. Here the wind was from the north, and came in squalls with heavy rain, and gradually increased during the day. The barque *Anne* was in latitude 15°39′N. and longitude 88°30′E. at a distance of about 50 miles to the north-west of the *Fuzzel Kurreem.* In the early part of the day the weather was calm and gloomy, but during the afternoon a north-easterly wind with drizzling rain, which gradually increased in strength, set in. The reading of the barometer of the *Anne* at 1 P.M. (29·561″ corrected to Calcutta) show that the pressure was low and diminishing over the area to the north-west of the Andamans. The Indian Government transport *Tenasserim* left Vizagapatam, with the Governor of Madras on board, on the evening of the 4th. Early in the morning of the 5th small whirlwinds and water-spouts were observed after a moderate squall from the south-east. The wind continued light and variable during the remainder of the morning, heavy banks of clouds forming to the east and north-east. The ship at noon was in latitude 16°41′N. and longitude 85°25′E. The wind at this time was from the north-east. At 1 P.M. sharp squalls with heavy rain were met with. The sea gradually rose, and the squalls became more frequent and violent. The barometer fell steadily during the remainder of the day. The *Satara* left the mouth of the Ganges on the day and proceeded south-east to Port Blair. The weather at the head of the Bay was very fine during the whole of the evening, with moderate easterly winds.

The logs of all these vessels indicate that during the afternoon of the 5th many of the conditions for the formation of a cyclone were present, and their logs for the next day will show it is probable that its formation took place during the evening of the 5th.

The chart for the day gives the isobaric lines of mean pressure together with the wind directions at 10 A.M. for the various observing stations. The positions of the ships are indicated by letters:—

The ship *Tenasserim* by the letter	T.
„ steamer *Tenasserim*	S. T.
„ *Fuzzel Kurreem*	F.
„ *Anne*	A.
„ *Satara*	S.

October 6th.—The chart of the 6th gives the isobaric lines and the wind directions at 10 A.M. These indicate plainly the formation of an area of barometric depression in the Bay. The barometer at Port Blair and Nancowry was ·05″ higher than on the preceding day at the same hour, whilst it had fallen considerably at Vizagapatam and the neighbourhood. It was at this station ·05″ lower than at Madras and ·08″ than at Saugor

Island. The wind directions at the coast stations show the same general circulation of the lower atmospheric strata around the Bay as on the previous two days. The mean pressure in the Gangetic plain was almost uniform, differing from 29·88″ by small amounts arising probably from slight local differences. The uniformity of the pressure over Northern India before and during the approach of the cyclone is a very marked feature. In the south of the Bay the general character of the weather was the same as on the previous day. At Nancowry and Port Blair the saturated south-west current still continued; 1·92 inches of rain were recorded at Nancowry and ·07″ at Port Blair. At the Ceylon stations the south-westerly current blew with increased velocity, and gave a considerable rainfall in the south of the island. At Galle 2·71 inches were registered. The rainfall at the central and northern stations was insignificant. The *Tenasserim*, which was 150 miles west of Port Blair at noon, encountered a gale from the south-west and south-south-west with very heavy squalls and torrents of rain. The log of the *Satara*, which was in latitude 19°40′, longitude 89°39′ at noon, shows that in the north of the Bay the weather early in the morning changed and became stormy, the wind increasing in squalls from the east, and attended with heavy rain. There was slight rainfall during the day at the head of the Bay. The fall at Calcutta was ·35″, at Jessore ·04″, at False Point 2·7″, and at Vizagapatam ·1″. The velocity of the wind was slightly greater along the west coast of the Bay, but in Behar and the North-Western Provinces it was less than on the previous day, averaging only from one to two miles per hour. The atmospheric motion in Upper India continued to indicate a gentle and steady current down the Gangetic valley. The atmospheric conditions on the morning of the 6th were—a general cyclonic movement of the winds round the coast; light winds and calms in Upper India; heavy rainfall with a strong south-west wind on the south-east of the Bay; diminishing pressure along the north-west and west part of the coast, accompanied by rainfall, which, however, was only heavy at False Point. The logs of the vessels traversing the middle of the Bay on this day—the *Anne*, *Fuzzel Kurreem*, Indian Government transport *Tenasserim*, and the *Liverno*—show that two cyclonic movements of the air originated in the centre of the Bay on the evening of the 5th. The first passed over the Indian Government transport *Tenasserim* and *Liverno* without inflicting much damage, and was probably much smaller than the second, which followed along nearly the same line after an interval of twelve hours, passing over the *Fuzzel Kurreem* and *Anne*, and dismasting both vessels. The exact position of the two latter vessels cannot be ascertained from their logs. They experienced the worst of the cyclone on the morning and afternoon of the 6th, the *Fuzzel Kurreem*, which was furthest to the east, from 9 A.M. until 4 P.M., and the *Anne* from midnight to 6 A.M. of the morning of the 6th.

The Indian Government transport *Tenasserim*, which was proceeding in a south-east direction across the Bay to Port Blair, passed through a cyclone on the morning of the 6th; she was then probably 200 miles at least to the west of the *Anne* and *Fuzzel Kurreem*. The cyclone was at its worst at 4 A.M. of the 6th, when very violent squalls passed over the vessel. The fall of the barometer from noon of the preceding day was ·49″. From the position of the vessel it is evident that this cyclonic disturbance cannot have been the same which dismasted the *Anne* and *Fuzzel Kurreem* on the same day much further to the east. The wind changed from north-east to north, north-west, west, and south-west. The centre of the cyclonic disturbance was thus at some distance to the north of the vessel and advancing in a north-west direction. The formation of a small cyclone to the west of the *Anne* and *Fuzzel Kurreem* on the evening of the 5th, and its advance in a north-westerly direction, are confirmed by the brief statement of the captain of the *Liverno*, that he met with a cyclone on her way to Calcutta in latitude 15°33′N., longitude 86°24′E., on the 6th. As the wind in this case changed from north to north-west, west, south-west, south, and south-south-east, the vortex must also have passed to the northward of this vessel in a north-westerly direction. The *Liverno* was at this time two hundred miles to the westward of the *Anne* and *Fuzzel Kurreem.* The position of the Indian Government transport *Tenasserim* when the cyclone passed over it is not stated, but apparently she must have been some distance to the west of the *Liverno*, and probably in latitude 15°30′N., longitude 85°45′E. The barometric observations at Vizagapatam, moreover, show the passage of a smaller atmospheric cyclonic disturbance on the afternoon of the 7th. The curve giving the changes of atmospheric pressure at Vizagapatam, freed from the changes due to the diurnal oscillation, and therefore representing solely the irregular and abnormal disturbances and changes, shows clearly the advance of a smaller cyclone which passed over or near Vizagapatam at 1 P.M. of the 7th, and was followed for a short time by a rising barometer, until the approach of the second cyclone again produced diminution of pressure.

If this formation and advance of a general cyclonic disturbance on the evening of the 5th and morning of the 6th be accepted, then the only way of accounting for the whole of the facts is to suppose that the varied weather of the 5th experienced by the *Anne*, *Fuzzel Kurreem*, and *Tenasserim*, all indicate the formation of a small cyclonic disturbance in advance of the larger and more extensive cyclone of the 6th, 7th, and 8th on the evening of the 5th in about latitude 15°N., which advanced north-west, passing at a short distance north of the *Tenasserim* and of the *Liverno* in latitude 15°45′N., and reaching the coast near Vizagapatam, by which time it had almost exhausted itself. The origin of the second cyclone can be ascertained more precisely. The ship *Anne* was clearly involved in the southern quadrant, from the fact that the wind changed from north-east to north, north-north-west, finally passing round to south-west. The vessel too must apparently, judging from the suddenness of the change from north-north-west to south-west (no indication of intermediate changes being recorded in the log), have been either involved in the centre or been very near to it. The wind in the case of the *Fuzzel Kurreem* is stated to have changed from north to north-east and then to south: hence this vessel must have been in the northern quadrant, and, for a similar reason to that given in the case of the *Anne*, was very near the centre. The fall of the barometer in the case of both ships during the passage of the cyclone was not very great. The barometer of the *Fuzzel Kurreem* fell from 29·75″ to 29·29″, and that of the *Anne* from 29·7″ to 29·3″. The *Fuzzel Kurreem* was to the east of the *Anne* on the 5th. She was involved in the storm from the morning of the 5th until the morning of the 7th, and was probably nearest the centre at 2 P.M. of the 6th. The *Anne* was involved in it from noon of the 5th until the afternoon of the 6th. This is quite consistent with the position of the vessels with respect to the path of the cyclone. The *Fuzzel Kurreem*, furthest to the east, first experienced the storm, and being in the northern quadrant, was drifted along in the direction of the line of advance of the storm, and was thus involved in it several hours longer than the *Anne*, which was in the southern quadrant, and drifted in the opposite direction. It is further confirmed by the facts that the cyclone was not a very extensive one, and that it moved westwards very slowly.

The cyclonic disturbance thus passed between the *Fuzzel Kurreem* and *Anne*, and probably nearer to the former vessel than the former. As the vessels at this time were on the 5th only 30 miles from each other and in a direction nearly parallel to the line of advance of the storm, but on opposite sides of it, the barometric depression at the centre of the storm (reduced for temperature) was probably not lower than 29·0″. At Vizagapatam, which was 16 miles from the centre at the time of the passage of the cyclone near it, the lowest reading was 28·832. The storm consequently became more concentrated and violent during its passage across the Bay. The origin of the second cyclone thus took place in the region of cyclonic generation north-west of the Andamans, and probably in latitude 14°30′N. and longitude 90°E. It moved first of all slowly towards the north-west nearly at right angles to the strong south-westerly saturated current blowing in this part of the Bay, passing between the ships *Fuzzel Kurreem* and *Anne*, and increased in strength and intensity as it advanced. In its passage across the Bay it was gradually deflected from a north-westerly to a west-north-westerly direction, striking the coast at or near Bimlipatam, as the information from the Ganjam coast district has already shown. The distance from the position of the *Anne* when the cyclone passed over it to Bimlipatam is very nearly 380 miles, assuming that the *Anne* was then in latitude 15°10′N. and longitude 89°20′E. The storm centre was nearest the *Anne* at 1 A.M. on the 6th, and passed over Bimlipatam at 3 A.M. on the morning of the 8th, if we assume that the centre was passing over this town when the storm was most violent at Vizagapatam. Its average rate of motion across the Bay after it passed the *Anne* was therefore only seven or eight miles per hour.

October 7th.—The cyclone disturbance passed to the south-west of the *Fuzzel Kurreem* on the afternoon of the 6th. During the day of the 7th it was crossing the Bay in a west-north-west direction towards the coast of Ganjam. The chart giving the isobaric lines and wind directions for 10 hours shows very distinctly its progressive motion westwards and its effect on the atmospheric circulation of Upper India. The pressure at 10 hours over the whole of the Gangetic plain was from ·02″ to ·03″ less than on the preceding day at the same hour. It had also fallen slightly at Port Blair and Nancowry and in Ceylon.

From Saugor Island southwards the fall was much more considerable, being nearly one-tenth of an inch at the outside of an elliptic area stretching along the coast from

Saugor to Madras, and the centre of which was near Vizagapatam, where the fall during the previous 24 hours had been ·28″. This great fall indicated the approach of the cyclone from the Bay. In the south of the Bay there was moderate rainfall at Nancowry and in Ceylon, and gloomy threatening weather at Port Blair, although no rain actually fell. The wind was almost due west in the morning in the south-east of the Bay, but changed round to south-west during the afternoon. At the stations in the south of Ceylon the wind, which was south-west in the morning, changed to west during the day, and was much stronger than on the previous day.

The ship *Tenasserim*, in latitude 14°8′ N. and longitude 90°13′ E. at noon, reports that the wind changed from south-south-west to south by east in her northward passage during the day and gradually decreased in strength. The *Satara*, 300 miles further north in latitude 18°30′ N. and longitude 90°52′ E., experienced a fresh south-east-by-south breeze and a fine clear sky. The sea was, however, still very heavy, the swell, according to the log of the *Tenasserim*, keeping up higher and higher during the day. The *Anne* and *Fuzzel Kurreem* had south-west winds with a confused sea, which, however, moderated during the day. The south-west winds therefore had established themselves much further to the west than on the previous day. The India Government transport *Tenasserim*, which was now well to the south-east of the area of cyclonic disturbance, had fine weather with southerly winds and a moderate sea.

The winds over the whole of Upper India as far west as Allahabad show the influence of the advancing cyclone. Over the whole area from Madras and Port Blair northwards to Lucknow and Allahabad and Cachar, the wind directions show a general cyclonic circulation around the area of depression advancing towards the Vizagapatam coast. The fact that the wind directions cut across the lines of equal pressure indicates the spiral tendency of the winds. The anemometric returns for the day also show increased velocity of the wind at all stations along the western coast except Madras, and at the stations in the Gangetic valley as far west as Lucknow. The wind observations for 16 hours show still more strongly the action of the advancing cyclone in modifying the winds at a great distance. The wind at Agra at 10 hours was south-west and at Roorkee south-east, apparently unaffected as yet by the cyclone; at 16 hours the wind at Agra had changed to north, whilst at Roorkee and Bareilly it was calm. The wind directions at Allahabad, Benares, Patna, Gya, Sumbulpore all approach closely to parallelism, showing also strongly the same tendency. This modifying action was felt to a distance of at least 850 miles, and gives some idea of the vast area affected by a small but concentrated disturbance of the atmosphere. The probable position of the centre at this time (4 P.M.) was in latitude 17°30′ N. and longitude 85° E.

October 8th.—The observations and information obtained from Vizagapatam and the neighbourhood have, as has already been stated, shown that the centre reached the coast at Bimlipatam about 3 A.M. on the morning of the 8th. The outer and western edge of the cyclone was then near the Eastern Ghâts. This range formed an effective barrier to the western advance of the cyclonic vortex. From Bimlipatam it changed its course from west-north-west to north, and travelled very slowly, passing over Vizianagram about 9 A.M. The chart for 10 hours represents the atmospheric conditions when the centre was two miles north of Vizianagram. It shows that the probable shape of the area of disturbance was elliptical, the direction of its motion bisecting very nearly the angle between the axes. From the statement of Major Wood of the comparatively small amount of damage inflicted on trees and houses at Vizianagram it is evident that during the seven hours in its northward course from Bimlipatam along the eastern base of the Ghâts it had been gradually breaking up, and that whether measured by the intensity of the winds or the barometric depression at the centre, it was at 10 A.M. much less influential and vigorous than when it reached the coast. This is also shown by the reversion of the wind at Agra to its normal direction, west. From Allahabad eastward the winds, however, still show clearly the general cyclonic motion round a centre at some distance north of Vizagapatam. The barometer during the preceding 24 hours had fallen ·04″ at Port Blair and ·08″ at Nancowry, whilst over the whole of the Gangetic plain the fall varied from ·08″ to ·11″. It was still very low at Vizagapatam, whilst at Cuttack and Sumbulpore it had fallen ·12″. In the eastern portion of the Bay itself the weather during the day was moderate. The sea was falling and the barometer rising rapidly over the central region. The *Tenasserim*, *Satara*, and India Government transport *Tenasserim* all report fine weather with south and south-westerly winds.

The chart for 16 hours presents the same features over the greater part of the area, viz. a considerable and general fall of the barometer during the previous 24 hours, the amount of the fall differing very slightly except near the cyclonic vortex. The pressure had increased ·1″ at Vizagapatam since 10 A.M., whilst it was falling slowly at Cuttack and Sumbulpore. The direction of the wind shows that the disturbance continued to preserve its original true cyclonic character, although the vortex was breaking up. The centre of the disturbance was at 4 P.M. to the south-east of Cuttack (probably a few miles to the north of Calingapatam), and was then travelling slowly northwards along the eastern base of the Ghâts. The anemometric returns show a very considerable increase in the wind velocity of the stations of Saugor Island, Calcutta, Hazaribagh, Burdwan, and a diminution at Cuttack, which is most probably owing to the fact that the vortex and the cyclonic movement near it was being gradually broken up by the irregular action and friction of the hills.

October 9th.—The isobaric lines and wind directions in the chart for this day are given for 10 A.M. These show that the centre of the area of barometric depression and of the disturbance was probably at a little distance—probably 35 or 40 miles—south-west of Cuttack. They also indicate that in the Gangetic valley eastward from Patna the barometric differences were still very slight, and that in this area there had been a slight fall of the barometer during the preceding 24 hours, excepting in the most western districts of the North-Western Provinces, where it was beginning to rise. The lowest recorded pressure at this hour was at Cuttack (29·55″), where it was ·12″ lower than on the previous morning; whilst at Calcutta and Saugor Island it had fallen ·05″, and at Vizagapatam it had increased during the same period from 29·31″ to 29·617″.

The wind directions as far west as Allahabad continue to present the same general spiral circulation around the central area of disturbance. Further west the winds seem to have little direct connection with these currents, although doubtless dependent on the cyclonic motion to the east. The *Tenasserim*, which was now in the latitude of Vizagapatam and proceeding to the mouth of the Hooghly, had moderate breezes from the south during the day, and although she was at least 200 miles from land, there were many birds and butterflies flying about, evidently drifted out far to sea by the strong west and south-westerly winds then prevailing at Vizagapatam and its neighbourhood.

Further south, at Port Blair and Nancowry, south-westerly breezes still continued, accompanied with showers. At Port Blair 1·6″ inches of rain was registered and at Nancowry ·3″. The *Satara* arrived at Port Blair on this day at 5 P.M., having experienced strong south-westerly winds with hard squalls and much rain. The S.S. *Ethiopia*, which was anchored off False Point on the 9th, had a fresh south-east gale in the morning, and was during the day within the region of cyclonic disturbance, the centre of which was then to the east of it. The changes of wind are quite consistent with this. She had heavy squalls during the day, the wind gradually changed from S.E. through S. by E. to S.S.W. and S.W. The period of the lowest barometric reading was at 6 P.M., but as the storm centre was now evidently being gradually dissipated by the action of the hills and smaller eddies probably formed, it is impossible to trace out accurately the rate and direction of its advance. The Cuttack and other returns indicate that it was now north of that station.

The anemometric returns for the day show a very considerable velocity of the air at the majority of stations within the circle of disturbance. Thus the number of miles registered was, at—

Saugor Island	462·8
Burdwan	166·6
Hazaribagh	374·2
Cuttack	211·9
Gya	155·2
Calcutta	143·4

There was also a considerable rainfall over the area of disturbance. It was greatest in Orissa and Chota Nagpore, although it was considerable over the whole of Bengal.

October 10*th*.—The chart for this day gives the curves of mean pressure for the day, and the wind directions at 10 A.M. The area including Gya, Hazaribagh, and Raneegunge was now the area of low pressure, the disturbance travelling almost due north. The differences of pressure were much smaller than on the preceding day. The centre of the area of low pressure and atmospheric disturbance apparently advanced along the edge of the high land, and reached the Ganges between Patna and Monghyr. At 10 A.M. the wind directions indicated plainly that the centre of disturbance was between Hazaribagh and Burdwan, and probably a short distance to the north of the joining line. The wind velocity at Cuttack and Saugor Island was considerably less than on the previous day, whereas at Calcutta, Hazaribagh, Patna, and Purneah it was very much greater. The region of heavy rainfall was almost coincident with the area of low pressure during the day. In Burdwan, Patna, Bhagulpore, and Rajshahye the rainfall during the day varied from two to three inches.

Rain continued to fall over Bengal until the 14th. The cyclonic disturbance gradually disappeared on the evening of the 10th and the morning of the 11th, when it reached the foot of the Himalayas. Heavy rain fell on the 11th in the Sarun and Chumparun districts to the west, but it is impossible to ascertain from the observations at the neighbouring observatories whether this was due to the cyclone itself or to the general southerly current from the Bay of Bengal which had again set in over Bengal.

The connection of the abnormal weather in the North-Western Provinces from the 13th to the 16th with the previous cyclonic disturbance does not belong properly to this report, and will be dealt with in the annual report of the Meteorological Reporter to the Government of India.

CHAPTER III.

General Conclusions.

THE following are the more important facts established by an examination of the various observations taken before and during the cyclone of the first week of October. At the beginning of October the distribution of pressure showed an approach towards uniformity over the Bay and Northern India. With the exception of local winds towards a small area of barometric depression at the head of the Bay, the circulation during the first two days tended towards a cyclonic movement round the coast of the Bay. This large cyclonic movement, gentle in its character, was quite established on the 3rd. During this and the following two days the south-westerly saturated winds in the south-easterly portion of the Bay increased in strength, and a considerable rainfall occurred over the greater part of this area. In the centre of the Bay the atmospheric pressure diminished, and smaller cyclonic movements were observed on the morning of the 5th. On the evening of the 5th a small cyclone was generated and passed north-westward, which spent itself out so far before it reached land that its effect on the barometric pressure, wind direction, and velocity at any of the coast stations, except Vizagapatam, cannot be separated from the effect of the second and much more powerful and intense cyclone which followed it. This second cyclone was generated during the afternoon of the 5th, passed between the *Fuzzel Kureem* and *Anne* on the 6th in a north-westerly direction, and reached the coast of Bimlipatam on the morning of the 8th, when it was advancing in a west-north-west direction. The Ghâts formed an effective barrier, and caused it to deflect and pass in a northward direction along their eastern base. The disintegrating action of the opposing masses of its spurs and of the land friction was such as to gradually break up the rapid active motion near the vortex, and to produce for some time an increasing cyclonic motion at greater distances from the centre. The centre of the area of depression advanced northwards past Cuttack and along the edge of the Chota Nagpore Hills, gradually dissipating on the 10th and 11th, having probably crossed the Ganges near Monghyr and advanced up to the hills, causing slight atmospheric disturbances east and west along the southern base of the Himalayas on the 11th.

Without attempting to give any general explanation of the origin of cyclones which, with suitable modifications, dependent on local and temporal conditions, will apply to all such storms, I shall now endeavour to discover if there were any assignable adequate causes at work during the first week of October for the formation of this particular cyclone. In doing so I hope to trace a sufficient connection between the actual phenomena and the forces and causes in operation during this period. But before attempting this, I shall test briefly the various theories put forward for cyclonic generation by the phenomena of the present cyclone. First, the vorticose or spiral motion of the atmosphere converging towards the centre is indicated too plainly in the various charts to permit the assumption of the circular theory as held by Reid, Piddington, and others. Also, there is no evidence of any distribution of the winds during the period preceding the cyclone which can in any way be considered as centripetal. The fact of the approximate approach to equilibrium of pressure over the whole of the Bay and Northern India on the 2nd and 3rd of the month is another argument against the adoption of Espy's hypothesis or Taylor's modification of it to explain the formation of this cyclone.

The hypothesis of parallel winds in opposite directions appears on dynamical grounds to fail to give an adequate cause for the motion of this large mass of air. That which may be more properly termed the cyclone was a rotatory cylinder of air forty miles at least in diameter moving with an average velocity of from thirty to sixty miles per hour, not regularly, but in irregular heavy gusts with intermittent lulls. Before the formation of the cyclone the logs of the *Tenasserim* and the wind returns of Nancowry show that there was on the eastern side of the Bay a moderate breeze blowing, probably at the rate of from four to nine miles per hour. On the opposite side of the Bay the north-easterly winds had only set in a few days before, and were blowing very gently and with an average velocity of from two to four miles. The period was evidently, so far as the winds were considered, one of transition, a passage through a state of equilibrium, in which the opposing forces producing the winds are in a state of neutralization and incompetent to give out enormous supplies of energy. There was also undoubtedly in the middle of the Bay variable winds and calms until, as shown by the log of the *Anne*, a few hours before the commencement of the cyclone. There was a rapid and enormous accumulation of energy in the space of a few hours, and I see no way in which the mere friction of two bodies of air moving with the slight velocities they are known on this occasion to have possessed upon a central and intervening mass could have accumulated so rapidly and so utterly distanced in velocity the motion of the producing masses. I assume that in the hypothesis of the parallel winds the primary motive-power is the friction, supplemented, as its upholders probably maintain, by the action of the heat given out during the condensation and rainfall which accompanies the cyclone. If this is the theory, it appears to resemble in precision of idea and language the ascription of the motive force of the explosive force of gunpowder to the fall of the hammer or the motion of the finger. It may be a necessary condition and an antecedent to the conversion of potential into actual energy; but it is not there that the believer in the principle of the conservation of energy would endeavour to find the source of the energy. I can only repeat that I believe no amount of friction between masses of air arranged according to the parallel wind hypothesis would suffice to communicate the energy which is absorbed by the vast moving mass of air forming a cyclone, and which is being very rapidly given out to the surface of the sea over which it passes, and in amount sufficient to raise the largest waves and produce the vast mechanical effects which the sea in a state of disturbance can effect, and which were strikingly shown at Vizagapatam by the scouring away of a depth of 14 feet of sand from a shoal near the harbour. Another objection is that the retarding friction between the vast moving mass of air and the sea must for equal surfaces be very much greater than that between masses of air.

Parallel opposite winds may be an antecedent and necessary condition, but it is not there the vast transfer and accumulation of energy must be sought.

The only remaining hypothesis is that of Mr. Blanford, a modified form of which seems to me to explain satisfactorily the formation and phenomena of the present cyclone. The explanation, I may premise, must account for the following antecedent conditions and assign an adequate cause for the following phenomena:—

1st.—It must explain the antecedent condition of opposite winds on the two sides of the Bay, and of the consequent tendency to a cyclonic circulation of the atmosphere round the coast of the Bay some days before the origin of the cyclone.

2nd.—It must explain the barometric depression which accompanies the setting in of the parallel winds, and precedes the formation of the cyclonic vortex of excessive barometric depression.

3rd.—It must explain why the cyclone advances in a northerly direction.

4th.—It must assign an adequate cause for the vast mechanical energy accumulated first as potential energy, and then given out rather after the nature of an explosive agent than that of ordinary matter unchanged in character and constitution and acted on by ordinary finite forces.

5th.—It must also explain the continuous addition of mechanical energy to the moving mass during its passage over the Bay.

First of all, the fact of opposite winds on different sides of the Bay, together with variable winds and calms in the mid Bay, indicates clearly a state of transition, a passage through a condition of unstable equilibrium. During such a period over the vast area of the Bay of Bengal, with its high temperature, an enormous evaporation is going on. The arrangement of the winds for some days before the cyclone was such as to afford no horizontal outlet to the increasing mass of aqueous vapour held in suspension in the air and forming a separate atmosphere. The regions to the south still continued to pour in supplies of moisture, and the passage northwards, which was its former outlet, was closed. The only action that can take place under these conditions is vertical expansion and motion. The constitution of aqueous vapour and its relation to the air, and the rate of decrease of temperature with elevation, are such that an equilibrated column of saturated air without condensation is physically impossible. Hence, under the conditions which preceded the present cyclone, evaporation would go on until the strata at some height above a considerable part of the Bay would become surcharged with vapour. This would occur on the south-east rather than on the north and north-west of the Bay, as in the former there is a double ascension—that due to the influx from the vast evaporating region of the Indian Ocean, as well as that due to evaporation from its own surface. Hence condensation and rainfall would necessarily follow, the amount being greatest in the south-eastern portion of the Bay and extending northwards with the persistence of the conditions. The saturated south-westerly current and the large precipitation, which Mr. Blanford states to be a constant element in the phenomena of cyclones, is thus, in my opinion, not the primary cause of the local barometric depression of the cyclone in the true sense of the word, but a natural and immediate result of the condition of uniformity of pressure round the limits of an almost closed water area which precedes the cyclone formation.

Consequent on the process of condensation is the giving out of an enormous amount of heat, exactly equivalent, either as heat or mechanical energy, to the solar heat or energy absorbed in the process of evaporation. The result of this is to produce a further upward expansion of the strata, in and above which condensation is going on, and of the contained aqueous vapour, to increase the rainfall, and to produce a continuous indraught from the surrounding lower region of the atmosphere to the region over which the 'ascendant courant' has now been established. This indraught takes place in accordance with dynamical principles, partially formulated in Dove's Law of Gyration, and naturally assumes a vorticose or spiral character, favoured and accelerated as it is by the previous distribution of winds round the coast. Thus the action of the vast quantity of heat given out during the process of condensation produces an extensive upward motion of the air over a portion of the Bay and gives the neighbouring air in the lower strata mechanical advantage. This action, a secondary effect of the evaporation and condensation over the region of evaporation, must be comparable with the producing cause—the vast mechanical energy of the heating power of the sun over the large central area of the Bay of Bengal.

This explanation seems to me to assign a sufficient, but not an exaggerated, part to the parallel winds on the opposite shores of the Bay, and to explain the presence of the powerful saturated current from the south-west in the southern part of the Bay. Both are evidently, on this explanation, concurrent phenomena which will generally precede the formation of cyclones in the Bay of Bengal. It assigns an adequate cause for the comparatively sudden accumulation of energy, and explains the indraught towards the centre and the barometric depression which precedes the formation of the vortex. It asserts that the action is due primarily to the cause condensation, which acts not continuously, but at irregular intervals, and is accompanied with a rapid disengagement of vast quantities of heat, which must be accompanied by mechanical action similar in character to the producing cause. It thus assigns a sufficient reason for the uniform character of cyclones, in which violent squalls lasting for some time are followed by lulls. The low barometer at the cyclone centre is due to the following causes: the previous barometric depression; the formation of a comparatively small cylindrical column of ascending vapour and air, due to the peculiar conditions, the upward motion of which is rapid compared with the slow vertical expansive motion taking place over the large area of evaporation; and finally, to the fact that the pressure of air in motion is always less than the pressure of air at rest under similar conditions of temperature and density.

It seems to explain also satisfactorily the north-westerly or northerly direction of the advance of cyclones from the place of their origin over the sea, and their generation in the central part of the Bay of Bengal to the west of the Andamans. The southern quadrant, the region of the indraught of the south-westerly saturated current, ought, theoretically, to be the more powerful as the producing causes; rapid condensation and precipitation are there more effective.

Again, from the evaporating region to the south a large supply of vapour continues to be poured in during the advance of the cyclone: hence, during the whole of the progress across the sea the same causes that were in operation to produce it continue to maintain it, viz. rapid condensation and precipitation of rain accompanied with the disengagement of vast quantities of heat into the air. The greatest rainfall will as a rule be on the south and east quadrants. Also as the cyclone advances, it forms the focus towards which the aqueous vapour generated towards the south tends and is the natural outlet for it: hence the comparatively fine weather which follows the passage of the cyclone, and the advance of the moisture current northwards. The presence of the Ghâts and the slowness of its advance after it reached the coast sufficiently account for the excessive rainfall during the cyclone on the Ganjam coast. The passage of the cyclone northwards through Chota Nagpore and Behar also explains the introduction of a strong and saturated moisture current into these districts from the Bay, and the subsequent considerable rainfall of the next four or five days.

APPENDIX A.

The following information was received from the Madras Government too late for insertion in the body of the report on the Vizagapatam cyclone:—

Rapport de Mer du navire français "Jules Rose," Capitaine A. Bellard, depuis son départ de Pondichéry jusqu'au moment de son naufrage.

Je suis parti de Pondichéry le 28 Septembre à 6 heures du matin en destination de False Pointe Ma traversée jusqu'à Ganjam s'est effectuée vent-arrière avec des courants Nord. Le 3 Octobre, des calmes, des vents variables du N.O. au N.E. et des courants Sud m'ont empéché de gagner au Nord.

Le 6 Octobre le point estimé me mettait, à 9 heures du matin, par 20 degrés de latitude Nord sur les Sondes. Le temps pluvieux empéchait de distinguer la terre; mais le changement de couleur de l'eau me la faisait supposer à environ 30 milles. A 9 heures 30′ pris la bordée du large pour m'écarter de la côte avec des vents de N.N.E. oscillant du N. au N.E., le baromètre à 754 millimétres en baisse; le vent par rafales, tout portait à croire qu'un cyclone sévissait dans le Sud.

Dans l'impossibilité de courir au Nord, j'ai dû continuer la cape forcée, babord amures. A midi, le petit hunier fût emporté, le baromètre étant tombé à 749 M.M. Vers 9 heures du matin le Samedi le baromètre recommençait à baisser, fais dégréer les cacatois et saisir tout pour essuyer le mauvais temps. Les vents ont souflé toute la nuit avec furie du N.N.E. le baromètre stable à 749 M.M. et les rafales devenaient de plus en plus violentes.

Ne voyant pas de variation dans les vents, essayé de laisser porter pour couper la ligne du centre en hissant le petit foc et établissant le point de la mizaine au vent; ces deux voiles furent immédiatement emportées; l'évolution ayant réussi, nous courions depuis une demi-heure au Sud, lorsqu'une lame a lancé le navire sur babord. Le grand hunier a été immédiatement défoncé et malgré tous les nouveaux essais, le navire n'a pas pu revenir vent-arrière. A 2 heures, la pluie a cessé et le vent est tombé rapidement; la mer est restée démontée du N.N.E. Le baromètre continue à baisser, profité du calme central pour occuper tout le monde à réparer les avaries, et à changer les rides des galhaubans pour la plupart fortement raguées.

Avec les premières fraîcheurs du Sud, pris les amures à tribord; à 6 heures du soir les premières rafales sont tombées à bord avec une force inouïe; impossible de nous tenir sur le pont et le baromètre tombé à 715 M.; pendant le calme remonté à 720 M.M. Je croyais en être quitte lorsque, dans une terrible rafale, le mât de mizaine est tombé en entrainant le grand mât de perroquet; toutes les voiles ont été emportées malgré les rabans.

Sans nouvelle variation de vent, le baromètre a recommencé à baisser et à 2 heures dans la nuit, il était à 715 M. et nous retombâmes bientôt dans le calme central, qui nous permit de nous débarasser des débris de mâture.

La pluie tombait toujours à torrents et de violentes rafales de S.S.E. succédaient subitement à un calme complet.

A 3 heures du matin lorsque l'estime me faisait au moins à 40 lieues de terre, j'ai aperçu des brisans sous le vent; la sonde jetée immédiatement a accusé 40 mètres et un violent courant à l'Ouest. Presqu'aussitot le navire a talonné sur des roches qu'il a franchies. Privé de toute voilure, j'ai ordonné

de préparer les ancres pour mouiller; mais avant que cette manœuvre pût être exécutée, le navire s'est trouvé drossé à la côte et s'est arrêté à ½ mille du rivage; quelques instants avant l'échouage le baromètre était à 709 M.M.

Presqu' aussitot après le navire s'est entièrement démoli et l'equipage s'est sauvé à la nage; sauf deux hommes, le charpentier et un matelot, qui manquaient à l'appel. La démolition de l'arrière du navire, vu l'état de la mer, a été si rapide que rien n'a pu être sauvé. D'après la position de l'échouage, tout porte à croire que le navire a talonné sur les roches de Santapilly; et que la grosse mer les lui a faites franchir.

Bimlipatam.—The Superintendent of Customs at this station states that on the evening of the 6th instant the barometer was at 29·79 and falling rapidly; the sea also commenced to swell. On the 8th, at 6·30 A.M., the wind shifted to S.W., blowing as a thick and very heavy squall with much rain. From 8 to 9·15 A.M. it came from the S.E., the barometer then standing at 29·25; at 10·30 A.M. the barometer had risen to 29·30. The weather was at this time muggy, with slight rain and a moderate breeze.

Santapilly.—The statement of the weather from the 5th to the 8th at this station was sent by Mr. Pascal, Superintendent of the Santapilly Light-house.

Date.	Hour.	Particulars.
5th	......	Moderate easterly winds : cloudy.
6th	......	Moderate easterly winds : clouds flying in all directions. Signs of a disturbance in the atmosphere.
	4 P.M.	Shower of rain.
	7 P.M.	Moderate north-westerly winds.
7th	4 A.M.	Dense clouds gathering with moderate northerly wind, accompanied with slight drizzle.
	1 P.M.	Wind increasing with heavy rain.
	7·30 P.M.	Wind veered to N.E., blowing at a velocity of 40 to 50 miles per hour, accompanied with rain.
	11·30 P.M.	Cyclone at its height. Velocity of wind from 60 to 70 miles per hour, accompanied with rain.
8th	4 A.M.	Wind veered to S. E., velocity still 60 to 70 miles an hour, accompanied with rain.
	6 A.M.	Wind veered to S., velocity decreasing. Raining still.
	12 noon.	Wind shifted to S.W. with rain.
	1 P.M.	Abated.

Calingapatam.—Mr. Varley, Conservator, gives the following information of the weather at this town a few miles east of Chicacole and on the sea coast :—

October 5th.—The day was fine with strong N.E. winds, but during the night, before and after midnight, it became murky and sultry; a heavy bank of clouds collected from E.N.E. to S.S.E., heaviest at S.E., emitting flashes of broad sheet lightning in quick succession.

October 6th.—The day throughout was cloudy with small rain. The wind was steady at N.E., increasing in strength. The weather assumed a threatening appearance at 6 A.M.

October 7th.—It blew a strong gale during the day. The wind at daylight was N., but changed to N.E. about noon, and continued at that point for the remainder of the day. The weather was very gloomy, with continuous drizzling rain. There was no thunder or lightning. The barometer at 6 P.M. stood at 29·48.

October 8th.—The wind during the day blew strong and steady from S.E. till 4 P.M., when it veered to S., from which point it lasted, blowing in strong gusts, with short intervals of lull, till midnight, when it veered to S.W. At 6 P.M. the barometer read 29·47, the lowest observed during the storm. At 8 P.M. the weather was still murky, but the wind inclined to subside. The force of the wind at this time was from high wind to a storm, the pressure in pounds per square foot ranging from 6 to 12¼lbs. by Molesworth's formulæ (*i.e.*, the wind velocity varied between 35 and 50 miles per hour) during the height of the storm from noon of the 7th to 6 P.M. of the 8th.

October 9th.—This day began with a clear sky and light W.S.W. wind.

Gopalpore.—The Master Attendant at this port writes as follows:—

On the morning of the 6th the weather changed suddenly. Before that it had been fine with a very moderate breeze from the N.E. Fitful gusts from the east set in early in the morning. A heavy bank of clouds appeared on the horizon to the S.E., and during the day we had passing showers. The barometer fell during the day. On the morning of the 7th the sea was a mass of foam, and the surf high, with a current running to the S.W. at about three to four knots. The sky was overcast, the clouds very low and travelling very fast, and there was a succession of heavy squalls with rain during the day. The tides on the evening of the 6th and morning of the 7th were five feet above their usual height. The clouds on the morning of the 7th were moving in circles in an oblique direction from the horizon, one part touching the sea and the N.W. extremity 35 to 40 degrees above, and the whole body moving at the same time northwards. The wind varied from E.N.E. to N.E., in which direction it blew before the lulls. The sea was in the afternoon a mass of foam, heavy swells rolling in, the surf breaking more than two miles off. The current was perceptible to the eye, and some drift was observed moving at least four knots per hour. At 6 P.M. the wind was E. by S., and nothing was visible seawards owing to the denseness of the clouds. During the whole night the wind continued to blow in heavy, angry gusts with occasional terrific squalls. During these squalls the force of the wind must have been 12. At daylight on the 8th the wind veered round to S.E., blowing a whole gale (force 11). There was a rapid succession of squalls with rain, the streams of rain (if I may so call them) being nearly horizontal. At 8 A.M. the sea was like a boiling caldron. The barometer stood at 29·76; it remained stationery till about 3 P.M., during which time the weather showed no signs of improvement. At 3 P.M. the barometer suddenly fell to 29·54, and at 4 P.M. to 29·51, the mercury being very unsteady. It was at this time impossible for any one to face the storm, as the sand from the beach was blowing up in dense clouds, covering the roads. At sunset it was still blowing hard, the barometer and wind being stationary. The wind began to moderate from midnight. At daylight of the 9th the barometer was still very low. The wind was S.W.; blue sky was now visible. The wind decreased during the day. The surf was still high, and the current running up to the N.N.E. at three knots per hour.

All the roads were covered with sand, in some places four feet deep. In front of the custom-house inside of the fence it is three feet deep.

The following table gives the observations taken during the storm:—

DATE.	WINDS.						WEATHER.		RAIN.		BAROMETER.			
	A. M.	Direction.	Force.	P. M.	Direction.	Force.	A. M.	P. M.	A. M.	P. M.	A. M.		P. M.	
October 5th ...	10	N.W.	2	4	N.E.	8	Fine.	Cloudy.	Nil.	Nil.	10	29·92	4	29·88
„ 6th ...	10	E.N.E.	3	4	N.E.	5	Cloudy.	Ditto.	1·01	·88	......	·88	...	·80
„ 7th ...	6	E.N.E.	8	2	E.	8	Ditto.	Ditto.	1·96	·25	6	·70	2	·65
„ „ ...	8	......	8	4	......	10	Ditto.	Ditto.	......	......	8	......	4	·63
„ „ ...	10	......	8	6	......	10	Ditto.	Ditto.	......	......	10	·68	6	·60
„ „ ...	12	......	8	......	......	......	......	......	......	......	12	·65	...	......
„ 8th ...	6	S. E.	10½	2	S.E.	10	Cloudy.	Cloudy.	·77	1·14	6	·59	3	·54
„ „ ...	8	......	10½	4	......	10	Ditto.	Ditto.	......	......	8	......	4	·51
„ „ ...	10	......	10	6	S.S.E.	8	Ditto.	Ditto.	......	......	10	......	6	·51
„ „ ...	12	......	10	12	S.	8	Ditto.	Ditto.	......	......	12	·56	...	......
„ 9th ...	6	S.	8	4	S.S.W.	4	Ditto.	Ditto	·81	·82	6	·51	2	·60
„ „ ...	10	S.S.W.	6	......	......	......	......	......	......	......	10	·54	4	·60
„ „ ...	12	S.W.	5	......	......	......	......	Fine.	......	......	12	·56	...	......

Ganjam.—The Port Conservator sends the following brief account of the weather at that town. It is situated on the coast about 160 miles to the N.E. of Vizagapatam:—

The weather from the 5th to the 8th was of the usual monsoon type in the month of October—a fresh breeze with occasional heavy squalls of wind and rain. The duration of each squall, which came on at intervals of about three and four hours, was from half an hour to an hour. They were very fierce and accompanied with heavy rain, but between the squalls the weather was not so bad. The wind was then what might be termed a moderate fresh breeze, and there was no surf at all. At 9·30 A.M. the sea was in a state of great commotion and of complete foam up to the anchorage, tumbling in from N.E., E., and S.E. The mail boat had before this made three attempts to take off the mails to the steamer *Oriental*, but was driven back swamped each time, and the steamer was obliged to proceed on her voyage without them. The wind increased during the remainder of the day, blowing in severe gusts, with short intervals of lull, and shifting from N.N.E. to E.N.E., but steadiest throughout the day from N.E. There were passing clouds, the sun occasionally showing out.

As there were no signs of any approaching cyclone, I only made the usual barometric observations, and noted the weather in the usual way. The following is an abstract of these observations:—

DATES.	8 A.M.			NOON.			4 P.M.			REMARKS.
	Barometer.	Thermometer.	Wind.	Barometer.	Thermometer.	Wind.	Barometer.	Thermometer.	Wind.	
5th	29·80	81	W.	29·77	83	N.E.	29·75	82	N.E.	Moderate breeze and cloudy; heavy rain at night.
6th	29·78	78	N.E.	29·78	78	N.E.	29·68	78	N.E.	Fresh squalls of wind and heavy rain throughout, and high surf.
7th	29·60	77	E.N.E.	29·55	79	E.N.E.	29·50	79	E.N.E.	Ditto ditto.
8th	29·50	79	S.E. by S.	29·46	82	S.E. by S.	29·40	81	S.E. by S.	Ditto ditto. Floods down the river.
9th	29·43	80	S.W.	29·45	83	S.S.W.	29·45	82	S.S.W.	Little cloudy, high surf, and floods down the river.

The additional information given in these returns confirms fully the path assigned to the cyclone vortex after it reached the coast on the morning of the 8th. The report from Bimlipatam is meagre and unsatisfactory. It makes no mention of a central calm. The area of calm was, however, probably very small, and may have passed over only a portion of the town. The report, whilst it adds nothing to the information already received, does not in any way invalidate the conclusions derived from the Vizagapatam observations and the information supplied by Major Wood.

The storm passed to the west of Calingapatam on the afternoon of the 8th, the barometer reading lowest at 6 P.M., when the wind was from the south, and shortly after which the weather began to show signs of clearing up. At Gopaulpore the wind was south on the night of the 8th and early on the morning of the 9th, the barometer during the whole of this time being low. Allowing for the changes due to the daily range, it would seem to have been lowest about 8 A.M. or 9 A.M. on the 9th. The wind at Ganjam changed from S.E. by S. to S.W. during the early morning of the 9th, whilst the lowest readings of the barometer were between 8 A.M. and noon. These observations are all in perfect accordance with the slow movement north-eastwards of a vortex gradually breaking up near the centre, but maintaining its force, slightly diminished, in the eastern outer limits of the cyclone area. The centre of the area of atmospheric disturbances, as has been shown, passed over Vizianagram at 9 A.M. on the 8th, and was a few miles to the S.W. of Cuttack at 10 A.M. of the 9th. These known positions and the later information indicate that the centre passed north-eastwards parallel to the coast, with a slow progressive motion of about six miles per hour, slightly greater than its rate of advance from the neighbourhood of Bimlipatam to Vizianagram, during which the great deflection occurred in its path.

The log of the *Jules Rose* is especially interesting, as it confirms the existence of the strong sea currents which accompanied the cyclone, previously assumed to explain the position and motion of the *Anne* and *Fuzzel Kurreem* relative to each other, and the path of the cyclone. The *Jules Rose* was first within the area of calm at 2 P.M. of the 7th. The barometer had fallen 34 millimetres (or 1·34″) during the preceding twelve hours. The cyclone passed on, and the vessel again experienced terrible squalls, which carried away the sails and mast. The vessel drifted at the mercy of wind and wave with the cyclone, and was again at 2 A.M. on the 8th in the central calm. Shortly after this, at 3 A.M., the vessel struck on the rocks near Santapilly, and was almost immediately broken to pieces. The lowest reading of the barometer was 709 m. m., 45 m. m. (or 1·77 inches) lower than on the morning of the 6th. The barometric depression at the centre was therefore most probably 27·9 or 28 inches.

APPENDIX B.

THE returns from the Ceylon observing stations were not obtained in time to be incorporated with the observations from the stations in Bengal and North-West Provinces, and are consequently given below as an appendix to the tables in section I, Chapter I :—

Barometric Observations (reduced to 32°) at Ceylon Stations—October 1876.

STATIONS.	1		2		3		4		5	
	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.
Galle	29·855	29·762	29·866	29·777	29·907	29·788	29·878	29·793	29·885	29·797
Trincomalee	·660	·558	·719	·551	·747	·553	·663	·516	·662	·594
Newara Eliya	24·049	23·954	24·125	23·960	24·125	23·952	24·127	24·042	24·131	23·968
Colombo	29·878	29·796	29·888	29·787	29·925	29·799	29·894	29·802	29·900	29·802
Kandy	28·235	28·134	28·271	28·162	28·281	28·150	28·257	28·178	28·269	28·168
Jaffna	......	......	29·900	29·762	29·935	29·787	29·902	29·767	29·889	29·778
Hambantota	29·834	29·700	29·834	29·780	29·865	29·758	29·842	29·756	29·853	29·747
Puttalam	29·882	29·813	29·895	29·771	29·931	29·799	29·907	29·797	29·902	29·803

STATIONS.	6		7		8		9		10	
	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h	9-30h.	3-30h.	9-30h.	3-30h.
Galle	29·893	29·779	29·879	29·769	29·843	29·740	29·827	29·734	29·836	29·806
Trincomalee	·690	·520	·617	·529	·585	·523	·572	·472	·689	·524
Newara Eliya	24·132	23·956	24·078	23·954	24·046	23·948	24·042	23·874	24·061	24·059
Colombo	29·897	29·793	29·882	29·786	29·853	29·782	29·839	29·754	29·911	29·821
Kandy	28·261	28·175	28·245	28·143	28·230	28·123	28·210	28·167	28·278	28·182
Jaffna	29·875	29·756	29·836	29·738	29·820	29·722	29·800	29·704	29·879	29·786
Hambantota	29·861	29·735	29·854	29·749	29·819	29·713	29·803	29·718	29·856	29·740
Puttalam	29·896	29·797	29·871	29·769	29·845	29·740	29·837	29·758	29·907	29·815

STATIONS.	20		21		22		23		24		25	
	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.
Galle	29·895	29·797	29·883	29·823	29·906	29·842	29·892	29·789	29·898	29·797	29·899	29·792
Trincomalee	·803	·655	·741	·623	·789	·658	·728	·636	·720	·666	·725	·619
Newara Eliya	24·166	24·042	24·154	24·042	24·153	24·050	24·145	23·966	24·129	23·974	24·139	24·032
Colombo	29·921	29·790	29·924	29·802	29·940	29·808	29·912	29·793	29·915	29·805	29·921	29·846
Kandy	28·276	28·179	28·278	28·183	28·293	28·228	28·260	28·179	28·259	28·175	28·283	28·190
Jaffna	29·960	29·846	29·956	29·841	29·960	29·867	29·952	29·839	29·939	29·833	29·933	29·855
Hambantota	29·882	29·784	29·869	29·782	29·891	29·796	29·867	29·789	29·866	29·753	29·884	29·772
Puttalam	29·951	29·812	29·964	29·827	29·948	29·820	29·936	29·803	29·954	29·805	29·939	29·843

STATIONS.	26		27		28		29		30		31	
	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.
Galle	29·899	29·773	29·879	29·762	29·865	29·730	29·867	29·739	29·817	29·723	29·845	29·753
Trincomalee	·700	·661	·683	·584	·703	·591	·671	·569	·626	·521	·636	·505
Newara Eliya	24·147	23·949	24·048	23·939	24·055	23·942	24·127	23·934	24·046	23·938	24·044	23·968
Colombo	29·927	29·817	29·915	29·802	29·890	29·816	29·904	29·797	29·846	29·733	29·859	29·768
Kandy	28·270	28·186	28·238	28·169	28·244	28·141	28·260	28·147	28·202	28·137	28·238	28·143
Jaffna	29·950	29·828	29·900	29·801	29·886	29·788	29·856	29·752	29·850	29·740	29·836	29·737
Hambantota	29·871	29·699	29·827	29·717	29·827	29·710	29·829	29·689	29·795	29·684	29·814	29·713
Puttalam	29·950	29·823	29·918	29·812	29·898	29·777	29·931	29·819	29·856	29·732	29·857	29·767

Mean daily atmospheric pressure (reduced to sea-level) at Ceylon Stations—October 1876.

STATIONS.	Height of station.	1	2	3	4	5	6	7	8	9	10
	Feet.										
Galle	40	29·849	29·862	29·888	29·876	29·882	29·877	29·865	29·832	29·821	29·887
Colombo	40	·880	·880	·905	·891	·894	·888	·877	·860	·839	·909
Kandy	1,650	·851	·883	·887	·889	·890	·888	·865	·846	·858	·908
Puttalam	11	·859	·844	·876	·863	·863	·858	·831	·803	·809	·872
Jaffna	9	...	·840	·870	·844	·842	·825	·796	·780	·761	·841
Trincomalee	175	·788	·814	·829	·768	·807	·782	·750	·731	·699	·783
Hambantota	40	·808	·848	·853	·845	·841	·839	·842	·807	·802	·839

STATIONS.	Height of station.	20	21	22	23	24	25	26	27	28	29	30	31
	Feet.												
Galle	40	29·887	29·894	29·915	29·881	29·888	29·886	29·877	29·861	29·838	29·844	29·811	29·840
Colombo	40	·898	·906	·917	·895	·903	·926	·915	·901	·896	·893	·832	·856
Kandy	1,650	·899	·901	·933	·891	·886	·906	·901	·875	·862	·877	·838	·861
Puttalam	11	·893	·906	·895	·881	·891	·902	·898	·876	·898	·886	·805	·823
Jaffna	9	·912	·908	·922	·905	·895	·903	·898	·859	·846	·813	·804	·796
Trincomalee	175	·908	·861	·902	·861	·872	·852	·860	·814	·827	·800	·752	·748
Hambantota	40	·874	·867	·884	·869	·851	·869	·826	·813	·810	·800	·780	·805

Wind Directions at Ceylon Stations—October 1876.

STATIONS.	1		2		3		4		5	
	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.
Galle	Calm.	S. W.	N. W.	W. N. W.	S. W.	S. W.	S. W.	W.	N.	S. W.
Trincomalee	S. E.	E.	S. W.	E.	S. W.	E.	S. W.	E.	S. W.	E.
Newara Eliya	S. E.	N. E.	S. E.	S. W.	S. W.	S. E.	N. E.	N. W.	N.N.W.	N. W.
Colombo	W.	W.	W.	W.	S. W.	W.	S. W.	W.	S. E.	S.
Kandy	S.	W	W.	S. W.	W.	W.	S.	S. W.	S. W.	W.
Jaffna	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.
Hambantota	S. W.	S. W.	S. W.	N. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.
Puttalam	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.
Mannar	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.

STATIONS.	6		7		8		9		10	
	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.
Galle	S. W.	S. W.	S. W.	W.	S. W.	S. W.	S. W.	W. S. W.	W.	N. W.
Trincomalee	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	E.
Newara Eliya	S. W.	N. W.	S. W.	S. W.	N. W.	N. E.	S. W.	S. W.	W.	S. W.
Colombo	W.	S. W.	W.	W.	S. W.	W.	W.	W.	S. W.	N. W.
Kandy	S. W.	W.	W.	W.	W.	W.	Calm.	Calm.	W.	W.
Jaffna	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.
Hambantota	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.
Puttalam	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.
Mannar	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.

STATIONS.	20		21		22		23		24		25		26	
	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.
Galle	N. E.	S. E.	N. E.	Calm.	N. E.	N. E.	N. E.	S. S. E.	N. E.	S. W.	N. W.	N.	N. W.	W. N. W.
Trincomalee	E.	E.	E.	E.	N. E.	N. E.	N. E.	N. E.	N. E	N. E.	W.	N. E.	N.	W.
Newara Eliya	N. E.	N. E.	S. S. E.	N. E.	S. E.	N. E.	N. E.	S. E.	S. E.	S. E.	N. E.	S. E.	N. W.	N. W.
Colombo	W.	S. W.	N. W.	S.	N.	S.	Calm.	W.	N.	N W.	N.	N.	N.	N. W.
Kandy	E.	E.	W.	W.	S. E.	Calm.	S. E.	Calm.	Calm.	W.	Calm.	Calm.	Calm.	Calm.
Jaffna	N.	N. E.	N. E.	N. E.	N. W.	N.	N. E.	N. E.	N. E.	N. E	N. E.	N. E.	N. W.	N. W.
Hambantota	N. E.	N. E.	N. E.	E.	N. E.	N. E.	S. E.	N. E.	S. W.	S. W.	N. E.	S. W.	S. W.	S. W.
Puttalam	N. E.	N. E.	N. E.	W.	S. W.	W.	N. E.	N. W.	Calm.	N. W.	N. E.	N. E.	Calm.	Calm.
Mannar	N. E.	N. E.	N. E.	N. E.	N. E.	N. E.	N. E.	N. E.	N. E.	N.	N. E.	N. E.	N. E.	N. W.

STATIONS.	27		28		29		30		31	
	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.	9-30h.	3-30h.
Galle	W. N. W.	N. W.	W. N. W.	S. W.	N. W.	W. N. W.	W.	W. N. W.	W. N. W.	W. N. W.
Trincomalee	S. W.	S. W.	W.	S. W.	S. W.	S. W.	S. W.	S. W.	S. W.	E.
Newara Eliya	Variable.	N. W.	N. W.	S. E.	N W.	N. W.	N. W.	N. W.	N. W.	N. W.
Colombo	N. W.	N. W.	Calm.	N. W.	N. W.	W.	S. W.	W.	S. W.	S. W.
Kandy	S.	S. W.	S. W.	W.	W.	Calm.	Calm.	W.	W.	W.
Jaffna	N. W.	Calm.	N. W.	Calm.	N. W.	Calm.	S.	S.	S.	S.
Hambantota	S. W.	N.	S. W.	S. W.	S. W.	S. W.	S. W.	S.	W.	S. W.
Puttalam	Calm.	N. W.	Calm.	N. W.	Calm.	N. E.	N. E.	S. W.	W.	S. W.
Mannar	N. E.	S. W.	S. W.	S. W.	S. W.	S. W.	S. E.	S. W.	S. W.	S. W.

Daily wind velocity at Ceylon Stations—October 1876.

Stations.	1	2	3	4	5	6	7	8	9	10
Galle	74·6	95·6	174·9	209·6	138·1	230·6	347·5	292·9	329·1	203·4
Trincomalee	......	192·5	53·4	93·5	101·6	186·3	360·0	432·1	427·5	419·3
Newara Eliya	7·7	7·7	4·8	11·9	3·0	2·2	12·2	30·8	12·9	6·3
Colombo	60·7	54·7	101·5	143·9	86·1	117·5	167·8	169·1	161·7	260·3
Kandy	17·1	20·7	21·1	40·0	33·4	55·9	42·7	58·5	74·7	36·9
Jaffna	384·5	156·7	185·4	198·5	365·1	397·2	340·6	312·6	317·4	296·0
Hambantota	197·1	193·0	212·9	290·1	235·0	231·0	280·9	206·1	260·0	200·0
Mannar	58·2	70·1	72·0	81·1	99·2	120·6	130·7	88·3	129·2	115·3

Stations.	20	21	22	23	24	25	26	27	28	29	30	31
Galle	30·2	40·8	37·4	33·1	93·5	82·0	81·8	165·5	177·6	185·4	199·8	257·5
Trincomalee	101·9	129·8	124·5	147·7	92·7	125·3	116·6	117·6	157·0	177·3	113·9	135·1
Newara Eliya	4·8	8·9	17·4	25·0	14·9	16·7	1·1	17·0	7·2	6·8	7·5	18·3
Colombo	47·5	103·2	116·1	98·8	30·6	96·2	105·1	124·4	158·7	92·2	159·6	168·1
Kandy	29·7	45·9	83·1	17·4	11·9	22·3	2·5	12·4	35·3	3·0	24·3	20·0
Jaffna	79·4	91·2	87·2	73·3	73·1	90·1	93·8	45·9	50·5	44·5	43·4	116·3
Hambantota	50·0	375·9	180·0	62·1	135·0	129·0	108·1	112·0	103·0	157·0	205·9	221·1
Mannar	49·8	60·4	60·0	57·6	179·3	89·8	81·1	64·0	19·5	37·3	28·0	33·7

Rainfall at Ceylon Stations from October 1st to 10th, and from 20th to end of month.

STATIONS.	1	2	3	4	5	6	7	8	9	10
Galle	0·12	......	0·11	0·01	0·91	2·71	0·14	0·04	0·16	......
Trincomalee	......	0·05	......	0·01	0·21	......	......	......	......	......
Newara Eliya	......	0·48	0·36	......	0·19	0·08	0·23	0·42	0·07	0·25
Colombo	......	......	......	4·10	0·20	0·60	0·15	0·31	0·51	......
Kandy	0·01	0·04	......	0·02	......	0·03	0·10	0·29	0·06	0·17
Jaffna	......	......	......	......	......	......	......	......	......	......
Hambantota	......	......	......	1·41	0·01	0·02	0·20	0·12	0·12	0·15
Puttalam	......	......	......	......	......	......	......	......	0·21	......
Mannar	......	......	......	......	......	......	......	......	......	......

STATIONS.	20	21	22	23	24	25	26	27	28	29	30	31
Galle	0·04	0·61	1·70	0·40	3·02	0·01	1·40	0·08	1·62	1·66	0·34	0·10
Trincomalee	0·21	0·72	0·07	......	......	0·34	1·80	0·27	0·22	0·17	0·20	......
Newara Eliya	0·15	0·08	0·20	0·05	......	0·07	0·12	0·48	0·75	0·37	0·05	0·14
Colombo	0·21	1·88	1·57	0·65	......	......	1·27	0·72	0·95	1·24	0·20	0·49
Kandy	0·01	0·16	0·35	0·02	0·08	2·73	0·02	0·47	1·22	0·81	0·07	0·16
Jaffna	......	......	......	......	......	......	0·02	0·22	2·07	......	......	......
Hambantota	......	......	2·00	0·16	......	......	0·21	0·47	0·06	0·13	......	......
Puttalam	1·62	0·71	0·36	......	......	......	......	0·22	1·51	......	0·26	......
Mannar	......	......	......	......	......	......	......	0·10	1·65	......	1·45	......

SECTION III.

THE BACKERGUNGE CYCLONE.

CHAPTER I.

The materials for the determination of the origin and line of advance of the Backergunge cyclone are unusually complete. A large number of vessels were at the head of the Bay, where they had arrived on the 29th and 30th, and were unable to proceed up the Hooghly on account of the stormy weather which was prevalent over the whole of centre and north of the Bay at this time. Several vessels were also passing northwards on the eastern side of the Bay. The logs of these ships furnish valuable information of the advance of the eastern quadrant of the cyclone.

The logs of these twenty-three vessels, all of which were involved in the cyclone, have been obtained by the Master Attendant of the Port of Calcutta.

Log of the S. S. "City of Venice," bound from Liverpool to Calcutta.

Wednesday, the 25th October 1876.

Hour.	Course.	Distance run.		Wind.		Barometer.	Temperature, air.	Temperature, water.	Remarks.
		Knots.	Fathoms.	Direction.	Force.				
A.M.									
1	S. 62° E.	11	4	Variable ...	......	......	......	......	Light variable airs and calm; in all sails.
2	"	11	4	......	......	......	......	......	2 A.M.—Altered course to S. 86° E. by mast.
3	S. 86° E.	11	4	......					
4	"	11	4	......	......	29·92	84	......	4 A.M.—Light N.Ely. air, and fine haze on horizon.
5	"	11							
6	"	11							
7	S. 73° E.	11	...	......					
8	"	11	...	North ...	2	29·92	84	......	8 A.M.—Light breeze, fine and clear.
9	"	11							
10	"	11							
11	"	11	...	......	......	......	......	......	Pumps duly attended.
12	"	11	...	......	......	29·94	84	84	Noon.—Wind light and variable with unsettled weather; in all sails.
P.M.									
1	"	11							
2	"	11	...	Variable ...	1 to 2				
3	"	11							
4	"	11	...	......	......	29·94	85	......	4 P.M.—Showery; altered course to E. by S. by mast.
5	S. 79° E.	11							
6	"	11							
7	"	11							
8	"	11	...	South ...	......	29·96	84	......	8 P.M.—Light breeze and clear; cloudy on horizon.
9	"	11							
10	"	11							
11	"	11							
12	"	11	...	......	......	29·96	82	......	Midnight.—Light breeze and cloudy.

Course	S. 71° 55′ E.	Longitude by account	74°40′ E.
Distance	270	Longitude by chronometer	74°47′ E.
Difference of latitude	84	Variation	5° E.
Latitude by account	7° 23′ N.	Distance run per log	266
Latitude observed	7° 30′ N.	Total distance	6,387
Difference of longitude	260		

Log of the S. S. "City of Venice," bound from Liverpool to Calcutta—(Continued).

THURSDAY, THE 26TH OCTOBER 1876.

Hour.	Course.	DISTANCE RUN.		WIND.		Barometer.	Temperature, air.	Temperature, water.	REMARKS.
		Knots.	Fathoms	Direction.	Force.				
A.M.									
1	S. 79° E.	11	...	Variable ...	2	......	......	......	Light variable winds, with cloudy unsettled weather.
2	"	11							
3	"	11							
4	"	11	...	......	......	29·90	82		
5	"	11	2	N. W. to North	2 to 3				
6	"	11	2			......	......	......	5 A.M.—Light breeze with rain squalls; set main trysail and jib.
7	"	11	2						
8	"	11	2	......	......	29·92	82	......	8 A.M.—Light breeze and overcast.
9	S. 73° E.	11	2						
10	"	11	2						
11	"	11	4	......	......	......	......	......	Pumps duly attended.
12	"	11	4	......	......	29·88	82	......	Noon.—Light squalls with heavy rain and very unsettled weather generally.
P.M.									
1	"	11	4	West ...	2				
2	"	11	4						
3	"	11	4	......	......	......	......	......	Set fore-topsail.
4	"	11	4	......	......	29·86	82	......	Very squally unsettled weather, with rain. 5-15 P.M.—Passed six miles off Point de Galle and signalized.
5	"	11	4						
6	"	11	4						
7	"	11	4	Variable ...	3				
8	N. 68° E.	11	4	......	......	29·85	81	......	8 P.M.—Squally unsettled weather.
9	"	11	4	......	......	......	......	......	11 P.M.—Altered E. to N.E. by E. ½ E. mast.
10	"	11	4	......	2				
11	N. 62° E.	11							
12	N. 67° E.	11	...	......	......	29·84	80	......	Midnight.—Squally unsettled weather.

Course	S. 75° E.	Longitude by account	79° 08′ E.
Distance	269	Longitude by chronometer	Obscured.
Difference of latitude	70	Variation	Ditto.
Latitude by account	6° 20′ N.	Distance run per log	269
Latitude observed	Obscured.	Total distance	6,656
Difference of longitude	261		

Log of the S. S. "City of Venice," bound from Liverpool to Calcutta—(Continued).

FRIDAY, THE 27TH OCTOBER 1876.

Hour.	Course.	Distance run.		Wind.		Barometer.	Temperature, air.	Temperature, water.	Remarks.
		Knots.	Fathoms.	Direction.	Force.				
A.M.									
1	N. 67° E.	11	...	W.S.W.	2	......	......	......	Light breeze, with overcast unsettled weather.
2	"	11	...	......	......	......	......	......	Course N.E. ½ E. by mast.
3	N. 49° E.	11							
4	"	11	...	......	......	29·86	80	......	4 A.M.—Altered course to N.N.E. ½ E. by mast.
5	N. 25° E.	11	...	West to N.W.	2	......	......	......	All fore and aft sail set.
6	"	11	...						
7	"	11	...		3				
8	"	11	...		......	29·90	81	......	8 A.M.—Moderate breeze, with dull unsettled weather; heavy bank on the N. and E. to E. horizon.
9	"	10	4						
10	"	10	4						
11	"	10	4	......	......	......	......	......	Pumps duly attended.
12	"	10	4	......	3 to 4	29·86	82	84	Noon.—Freshening breeze with rain (working up from eastward).
P.M.									
1	N. 22° E.	10	6						
2	"	10	6						
3	"	10	6	......	......	......	......	......	3 P.M.—Furled main trysail and jib.
4	"	10	6	......	......	29·80	82	......	4 P.M.—Moderate breeze, with light squalls and dull unsettled weather.
5	"	10	4	N.N.W.	3 to 4				
6	"	10	4						
7	"	10	4						
8	"	10	4	......	......	29·82	82	......	8 P.M.—Moderate variable wind, with very heavy rain squalls and dark overcast sky.
9	"	10	4	Variable ...	3 to 4				
10	"	10	4						
11	"	10	4						
12	"	10	4	......	......	29·82	82	......	Midnight.—Similar weather, with northerly swell.

Course	Various.	Difference of longitude	203
Distance	260	Longitude by account	82° 31′ E.
Difference of latitude	87	Longitude by chronometer	Obscured.
Latitude by account	7° 47′	Distance run per log	267
Latitude observed	Obscured.	Total distance	6,916

Log of the S. S. "City of Venice," bound from Liverpool to Calcutta—(Continued).

SATURDAY, THE 28TH OCTOBER 1876.

Hour.	Course.	Distance run.		Wind.		Barometer.	Temperature, air.	Temperature, water.	Remarks.
		Knots.	Fathoms.	Direction.	Force.				
A.M.									
1	N. 22° E.	10	4	From West to North and E. N. E.	......	......	......	......	Frequent heavy squalls of wind and rain, attended with vivid lightning and heavy thunder and dark cloudy weather generally; occasional N.N.W. and E.N.E. swells.
2	„	10	4		2 to 6				
3	„	10	...						
4	„	10	...			29·74	78		
5	„	9	4						
6	„	9	4						
7	„	9	4						
8	„	9	4	......	4	29·80	80	......	8 A.M.—Squalls also frequent; breeze steadier, with dull overcast weather.
9	„	9	4	Back to North.					
10	„	9	4						
11	„	9	4		......	......	......	......	Pumps duly attended.
12	„	9	4	......	......	29·70	80	82	Noon.—Fresh breeze, with heavy squalls of wind and rain; very confused sea rising; barometer fluctuating a tenth, and bad appearance from S.E. to N.E. Got everything well secured.
P.M.									
1	„	8	2	Between N. N. E. and N. N. W.					
2	„	8	4						
3	„	8	4		5				
4	„	8	4		......	29·70	80		
5	„	8	4						
6	„	8	4						
7	„	8	4						
8	„	8	4	......	......	29·72	82	......	8 P.M.—Fresh gale, with heavy squalls and high cross sea; vessel rolling and straining and shipping loose water on deck.
9	N. 23° E.	8	4	......	6				
10	„	8	4						
11	„	8	4						
12	„	8	4	......	......	29·70	80		Midnight.—Hard squalls, with bad-looking weather.

Course	N. 25° E.	Longitude by acccount	84°17 E.
Distance	244	Longitude by chronometer ...	......
Difference of latitude	221	Longitude observed	......
Latitude by account	11° 28′ N.	Distance run per log	244
Latitude observed	......	Total distance	7,160
Difference of longitude	106		

Log of the S. S. "City of Venice," bound from Liverpool to Calcutta—(Continued).

SUNDAY, THE 29TH OCTOBER 1876.

Hour.	Course.	Distance run.		Wind.		Barometer.	Temperature, air.	Temperature, water.	Remarks.
		Knots.	Fathoms.	Direction.	Force.				
A.M.									
1	N. 22° E.	8	...	Between N.N.E. and N.N.W.	......	......	......	......	Moderate gale, with continuous rain; dark threatening weather, with high cross sea, heaviest from east; ship straining and labouring considerably.
2	"	8	...						
3	"	8	...						
4	"	7	...		7	29·64	82		
5	"	7	...						
6	"	7	...						
7	"	6	4		......	......	......	......	8 A.M.—Strong gale, with heavy squalls and confused sea.
8	"	6	4		......	29·67	81		
9	"	6	4						
10	"	6	4		......	......	......	......	Pumps carefully attended.
11	"	6	4	......	......	......	......	......	Noon.—Strong gale, with hard squalls and very confused sea; ship pitching and labouring very heavily; barometer fluctuating between 29·60 and 29·70.
12	"	6	4	......	......	29·61	81	82	
P.M.									
1	N. 34° E.	6							
2	"	6							
3	N. 22° E.	4	4	......	......	......	......	......	2 P.M.—Half speed. 3 P.M.—Slowed engines.
4	N. 11° W.	2	4	......	......	29·55	80	......	4 P.M.—Hard gale, with furious squalls from N.E. and N.N.E. and rain; sea high and increasing from E., E.N.E., and N E., causing a very confused surface; ship labouring and pitching very heavily and taking large quantities of water on deck.
5	N. 5° W.	2	4	N. by E.	7 to 9				
6	"	2	4						
7	"	2	4						
8	"	2	4	......	......	29·58	80		
9	North.	2	4						
10	"	2	4						
11	"	2	4						
12	"	2	4	......	......	29·54	80	......	Midnight.—Similar weather.

Course	N. 23° 30′ E.	Longitude by account	85° 33′ E.
Distance	185	Longitude by chronometer... ...	......
Difference of latitude	169	Variation	......
Latitude by account	14° 17′ N.	Distance run per log	185
Latitude observed	......	Total distance	7,845
Difference of longitude	76		

Log of the S. S. "City of Venice," bound from Liverpool to Calcutta—(Continued).

MONDAY, THE 30TH OCTOBER 1876.

Hour.	Course.	Distance run.		Wind.		Barometer.	Temperature, air.	Temperature, water.	Remarks.
		Knots.	Fathoms.	Direction.	Force.				
A.M.									
1	North.	2	4	N. by E.	Between 7 and 9	......	......	......	Hard gale, with fierce squalls of wind and rain, thick dark weather, and high confused sea.
2	,,	2	4						
3	,,	2	4						
4	,,	2	4			29·46	82		
5	,,	2	4						
6	,,	2	4			......	......	......	6. A.M.—Increased to half speed, but ship labouring and straining; slowed again.
7	,,	2	4						
8	,,	2	4		......	29·52	81	......	9-20 A.M.—Kept away to S.W.; attempted to set jib, but blew out of bolt and rope.
9	,,	2	4						
10	S. 45° W.	6	...						
11	,,	8	...		......	......	......	......	Pumps duly attended.
12	,,	8	...	......	......	29·50	81	82	Noon.—Wind westering a little; weather the same. 2 P.M.—Weather decidedly improving.
P.M.									
1	,,	8	4	N by W.	Between 6 and 8				
2	,,	8	4			......	......	......	2-30 P.M.—Brought ship to N.E ½ E. by mast, with double-reefed and fore staysail; full speed.
3	,,	7	...						
4	N. 61° E.	7	...	N.N.W.		29·48	80	......	4-30 P.M.—Compelled to lower again; ship pitching and labouring very heavily; weather improving.
5	,,	6	...						
6	,,	4	...						
7	N. 79° E.	5	...	N.W.		......	......	......	6 P.M.—Kept away to E. by N. by mast.
8	,,	5	...		......	29·56	82	......	8 P.M.—Strong gale, veering west; sea very high and confused; heavy to N.E.
9	,,	5	...		......	......	......	......	9 P.M.—Set double-reefed main topsail.
10	,,	5	...		......	......	......	......	10 P.M.—Vessel labouring and pitching; kept away E.N.E.
11	N. 56° E.	6	...	W.N.W.					
12	,,	6	...		......	29·50	82	......	Midnight.—Strong gale, with heavy squalls and high irregular sea.

Course	...	...	N. 24° W.
Distance	...	...	47
Difference of latitude	...	...	42° 06′
Latitude by account	...	...	14° 19′ N.
Latitude observed	...	...	......
Difference of longitude	...	...	20° W.

Longitude by account	...	...	85° 15′ E.
Longitude by chronometer	...	...	......
Longitude observed	...	...	......
Distance run	...	...	......
Total distance	...	...	7,392

Log of the S. S. "City of Venice," bound from Liverpool to Calcutta—(Continued).

TUESDAY, THE 31ST OCTOBER 1876.

Hour.	Course.	Distance run.		Wind.		Barometer.	Temperature, air.	Temperature, water.	Remarks.
		Knots.	Fathoms.	Direction.	Force.				
A. M.									
1	N. 68° E.	8	...	West.	......	......	......	......	Gale not steady, at times blowing moderate, at others very hard with frequent squalls of wind and rain, and very high irregular sea, causing ship to pitch and labour; straining and taking heavy water on board at times; sky more broken.
2	"	8	...		Between 6 and 9				
3	"	8	...						
4	"	8	...			29·44	80		
5	"	8	...		......	......	......	......	5 A.M.—Set single-reefed try-topsail.
6	"	8	...	W. by S.	......	......	......	......	6 A.M.—Hauled up to N.E. by mast.
7	N. 45° E.	8	...						
8	"	8	...		......	29·54	80	......	8 A.M.—Strong steady gale, with hard squalls; sea a little more regular from N.E. and N.W.
9	"	8	...						
10	"	8	...	W.S.W.	8				
11	N. 32° E.	9	...						
12	"	10	...		......	29·56	81	80	Noon.—Similar wind, weather, and sea.
P.M.									
1	"	10	...		......	......	......	......	Pumps very carefully attended.
2	"	10	...		7				
3	"	10	...						
4	"	10	...		......	29·56	82	......	4 P.M.—Gale broken; barometer steadily rising and rather improving; heavy cross sea.
5	N. 25° E.	9	...						
6	"	9	...						
7	N. 12° E.	9	...	West.					
8	"	9	...		6 to 7	29·69	82	......	8 P.M.—Decreasing breeze; sea moderating; weather overcast; clearing overhead.
9	N. 11 °E.	9	...						
10	"	9	...						
11	"	9	4		6				
12	"	9	4		......	29·70	82	......	Midnight.—Fresh breeze, with rain squalls; sky clearing at intervals.

Course	N. 51° 4′ E.	Difference of longitude	108
Distance	143	Longitude by chronometer... ...	87° 02′ E.
Difference of latitude	84	Variation	13° E.
Latitude by account	......	Total distance	7,526
Latitude observed	16° 23 N.		

Log of the S. S. "City of Venice," bound from Liverpool to Calcutta—(Concluded).

WEDNESDAY, THE 1ST NOVEMBER 1876.

Hour.	Course.	Distance run.		Wind.		Barometer.	Temperature, air.	Temperature, water.	Remarks.
		Knots.	Fathoms.	Direction.	Force.				
A.M.									
1	N. 11° E.	9	4	West.	5				
2	„	9	4						
3	„	9	4						
4	„	9	4	……	……	29·72	80	……	4 A.M.—Fresh breeze, fine and clear, with heavy N. and N.W. swell.
5	„	9	4						
6	„	9	4	W. N. W.	4				
7	„	10	…						
8	„	10	…	……	3	29·83	82	……	8 A.M.—Moderate, fine and clear; less swell.
9	Variation.	9	4						
10	„	9	4						
11	„	2	…	……	……	……	……	……	11-40 A.M.—Proceeded; pumps duly attended.
12	North.	9	…	……	3	29·83	83	82	Noon.—Moderate, fine and clear.
P.M.									
1	N. 11° W.	9	4						
2	„	9	4						
3	„	9	4						
4	„	9	4	……	2	29·80	84	……	4 P.M.—Light air and fine.
5	N. 4° W.	10	…						
6	„	10	…						
7	„	10	…						
8	„	10	…	……	1	29·84	82	……	8-40 P.M.—Passed pilot brig.
9	„	10	…						
10	„	10	…						
11	„	10	…						
12	„	10	…	……	……	29·88	81	……	Midnight.—Light air, fine and clear.

Course … …	N. 25° 46′ E.	Longitude by account … …	88° 32
Distance … …	171	Longitude by chronometer… …	88° 20′ E.
Difference of latitude … …	154	Variation … …	10° E.
Latitude by account … …	20° 08′	Distance run per log … …	220
Latitude observed … …	18° 57′	Total distance … …	7,697
Difference of longitude … …	78°		

Abstract of Log of the Ship "Empire of Peace."

27th October, latitude 8° 50′ *north, longitude* 91° 45′ *east.*—Thick, cloudy weather, with much rain; wind from S. to S.S.W.; barometer from 29·70 to 29·78 working tides.

28th October, latitude 12° 5′ *north, longitude* 91° 20′ *east.*—Strong breeze and thick, with much rain; wind S.E.; all light sails fast. Midnight.—Wind increasing, with heavy rain, so made fast all sails except lower topsails. Towards noon more moderate; set foresail. Glass acting as yesterday.

29th October 1876, *latitude* 14° 50′ *north, longitude,* 91° 20′ *east.*—Fresh gale from E.S.E., and thick rainy weather; glass working tides from 29·68 to 29·75; ship running under reefed topsails, reefed courses. At 8 A.M. weather so threatening, hove ship to; glass 29·65; towards noon cleared up, wind moderated a little, and the barometer rose to 29·68.

30th October 1876, *latitude* 17° 25′ *north, longitude* 91° 45′ *east.*—At 1·30 P.M. run ship under lower fore and main topsails N.W. by N; wind fresh; gale from E.S.E., with heavy rain; squalls very heavy from S.; wind strong gale; glass 29·55, and falling; hove ship to on starboard tack under lower main topsail and storm spanker. 6 A.M., washed hatch-house overboard and a lot of bulwarks off the port side.

31st October 1876, *latitude* 19° 30′ *north, longitude* 91° 20′ *east.*—Blowing now cyclone from E. S. E. 1 P.M., lower main topsail split; 5 P.M., storm spanker; 6 P.M., cut away fore-topgallant mast to save the ship and lives on board; glass then 29·18 inches. At 10 P.M. main and mizen topgallant both blown away; wind then S., and cyclone at its height. Midnight, wind S.S.W., still blowing very hard and a fearful sea; rudder head gave way. At 6 A.M. cyclone left the ship; wind S.W.; at 7 A.M. got rudder secured; hands employed clearing wreck and setting what little sail we have left all day.

Arrived at Sandheads on the 11th November. Experienced after cyclone very strong southerly current, and saw a great number of dead cattle.

H. WILLIAMSON, *Master.*

Log of the French Brig "Arabia" from 27th October to 2nd November.

Du Vendredi 27 au Samedi Octobre 1876.

Heures.	Vents.	Routes.	Nœuds.	Dérive.	Voilure.	Evenements.
1	Ouest.	N.N.E.	7	......	Les voiles majeures.	Temps pluvieux, belle brise, mer un peu grosse, houles du N.E., envoyé une bordée en bas, pluie incessant. Pompe franche.
2	„	„	7	......	„	
3	„	„	7	......	„	
4	„	„	7	......	„	
5	S.O.	„	7	......	„	Même temps, à 5.30, serré la grande voile, vers 7-45; les vents passent au Sud, brassé carré, continuation de pluie. Pompe franche.
6	„	„	7	......	„	
7	„	„	7	......	„	
8	„	N. ¼N.E.	7	......	„	
9	Sud.	„	8	......	„	Même temps et même voilure que le quart précédent, brise plus fraîche, mer grossissante. Pompe franche.
10	„	„	8	......	„	
11	„	„	8	......	„	
12	„	„	8	......	„	
1	S.S.E.	„	9	......	„	Temps à grains, à 1.45 serré le grand perroquet les vents halent le S.S.E., les grains ne font que se succéder. Pompe franche.
2	„	„	9	......	„	
3	„	„	9	......	„	
4	„	„	9	......	„	
5	„	„	9	......	„	Même temps, rien de changer au quart précédent, mer grosse. Visite du gréement. Pompe franche.
6	„	„	9	......	„	
7	„	„	9	......	„	
8	„	Nord.	9	......	„	
9	„	„	8	......	Les perroquets.	Même temps, la brise mollit entre les grains. Un navire coupant notre route nous signale sa longitude qui est 90°. Pompe franche.
10	„	„	8	......	„	
11	„	„	8	......	„	
12	„	„	8	......	„	
Latitude	...	...	...	...	... ...	11° 50′ Nord.
Longitude	...	...	...	...	... ...	89° 01′ Est.
						Baromètre ... ... 7·55

Du Samedi 28 au Dimanche 29 Octobre 1876.

1	S.E.	N. ¼N.E.	8	......	Les voiles majeures.	Temps à grains, mer grosse, forte brise dans les grains, pluie continuelle. Aperçu un navire devant courant E.N.E. Pompe franche.
2	„	„	8	......		
3	„	„	8	......	„	
4	„	„	8	......	„	
5	„	„	8	......	Grand perroquet.	Même temps, à 5 heures établie la grand voile, le temps prend meilleur apparence. Pompe franche.
6	„	„	8	......	„	
7	„	„	8	......	„	
8	„	„	8	......	„	
9	„	„	8	......	„	Même temps, vers 9 heures la brise fraîchit d'avantage, fort tangage, serré les volants, à 10 heures fort grain. Pompe franche.
10	„	„	8	......	„	
11	„	„	8	......	„	
12	„	„	8	......	„	
1	„	„	7	......	Les volants.	Même temps, le brise souffle de plus en plus avec violence, les grains se succèdent sans interruption. Pompe franche.
2	„	„	7	......	„	
3	„	„	7	......	„	
4	„	„	7	......	„	
5	Est.	„	7	......	Les misaines et le pt. hunier.	Temps très mauvais, les vents soufflant avec violence de l'Est, à 8h. pris la cape courante sous les 2 huniers fixes. Pompe franche.
6	„	„	7	......		
7	„	„	7	......		
8	„	„	7	......		
9	„	N.E.	1	6·4	Le grand hunier et le point foc.	Même temps, à 8.30 pris la cape sèche, brise toujours très violente et mer tres grosse. Pluie torrentielle. Pompe franche.
10	„	„	1	B.		
11	„	„	1	„		
12	„	„	1	„		
Latitude	...	...	...	...	... ...	14° 19′ Nord.
Longitude	..	...	...	...	... ...	89° 30′ Est.
						Baromètre ... ... 7·56

Log of the French Brig "Arabia" from 27th October to 2nd November—(Continued).

Du Dimanche 29 au Lundi 30 Octobre 1876.

Heures.	Vents.	Routes.	Nœuds.	Dérive.	Voilure.	Evenements.
1	S.E.	N.E.	1	6-4	En cape sèche.	Temps noir et de mauvaise apparence, le vent soufflant avec violence du S.E., mer grosse de l'Est. A 1 heure en carguant le grand hunier toutes les cargues ont cassées, employé une pièce de 32 fils à changer toutes les cargues du grand hunier et cargue point du point hunier. Pompe franche.
2	„	„	1	B.	„	
3	„	„	1	......	„	
4	„	„	1	......	„	
5	„	„	1	......	La misaine et le grand hunier	
6	„	„	1	......		
7	„	Nord.	7	......		
8	„	„	7	......		
9	„	„	7	......	„	Même temps, les vents culent au S.S.E., à 6 heures relevé la cape et pris la fuite au Nord sous le grand hunier fixe et la mizaine. Pompe franche.
10	„	„	7	......	Le point hunier.	
11	„	„	7	......		
12	„	„	7	......	„	
1	„	„	7	......	„	Même temps et même voilure que le quart précédent, petite pluie jusque vers 5.30, mer excessivement grosse. Pompe franche.
2	„	„	7	......	„	
3	„	„	7	......	„	
4	„	„	7	......	„	
5	Est.	„	5	......	„	Temps sombre, les vents ne font que redoubler de violence et la mer est de plus en plus grosse, á 7.30, les vents halent. Pompe franche.
6	„	„	5	......	„	
7	„	„	5	......	„	
8	„	„	5	......	„	
9	„	„	5	......	„	Même temps, fortes raffales à de courtes intervalles, á 10 heures mis en cape sèche. Pris les bras du grand cacatois pour servir de cargues au petit hunier. Pompe franche.
10	„	„	5	......	„	
11	„	N.E.	1	6-4	En cape sèche.	
12	„	„	1	B.		
Latitude	...	...	...	...	... ...	15° 06′ Nord.
Longitude	...	...	...	...	... ...	89° 27′ Est.
						Baromètre ... ... 7·53

Du Lundi 30 au Mardi 31 Octobre 1876.

1	S.E.	N.E.	1	6-4	En cape sèche.	Temps sombre, les vents soufflent toujours avec une grande violence, des nimbus chassent rapidement du S.E., mer très grosse. Pompe franche.
2	„	„	1	B.		
3	„	„	1	......	„	
4	„	„	1	......	„	
5	„	„	1	......	„	Coup de vent, les vents soufflent avec on ne peut plus de violence du S.E.; la mer est affreuse, le navire fatigue énormément et les coursives sont ouvertes partout, les manœuvres sont mangées par le vent, le baromètres à 7.50 ne fait que baisser davantage, les raffales sont de plus en plus fortes, de temps à autres des lames énormes viennent frapper contre le navire et le submerge de l'avant á l'arriére.
6	„	„	1	......	En cape à sec de toile.	
7	„	„	1	......		
8	„	„	1	......		
9	„	„	1	......	„	
10	„	„	1	......	„	
11	„	„	1	......	„	
12	„	„	1	......	„	
1	„	„	1	......	„	Le temps prend de plus en plus mauvaise apparence, les vents soufflent avec une telle intensité que le navire est quelque fois des minutes à se relever. Le gouvernail ressent de très fortes secousses. Pompe franche.
2	„	„	1	......	„	
3	„	„	1	......	„	
4	„	„	1	......	„	
5	„	„	1	......	„	
6	„	„	1	......	„	
7	„	„	1	......	„	
8	„	„	1	......	„	
9	„	E.N.E.	1	......	„	
10	„	„	1	......	„	
11	„	„	1	......	„	
12	„	„	1	......	„	
Latitude	...	...	...	...	... ...	....
Longitude	...	...	...	...	... ...	Baromètre ... ... 7·47

Log of the French Brig "Arabia" from 27th October to 2nd November—(Concluded).

DU MARDI 31 OCTOBRE AU MERCREDI 1 NOVEMBRE 1876.

Heures.	Vents.	Routes.	Nœuds.	Dérive.	Voilure.	Evenements.
1	S.E.	N.E. ¼ E.	1	8-4	En cape à sec de	Fort cyclone, mer horriblement grosse, le baromètre a encore une tendance à la baisse, vers 2·30 étant occupér à affaler les chaines dans le puit les vents soufflent avec une telle violence que le navire couche et le côté de bâbord est envahi par la mer, les sabords sont défoncés et les pièces à eau ainsi q'une partie des pavois. Vers 2.30 ne pouvant plus tenir obligé de couper le grand mat qui entraine dans sa chute la tête du mât de flèche, casse la vergue du petit basris, les voiles sont mangées par le vent, le canot est emporté.
2	„	„	1	B.	toille.	
3	„	„	1	......	„	
4	„	„	1	......	Bar. 7·40.	
5	„	„	1	......	Le grand mat.	
6	„	„	1	......		
7	„	„	1	......	„	
8	„	„	1	......	Bar. 7·36.	
9	„	„	1	......	„	
10	„	„	1	......	„	
11	„	„	1	......	„	
12	„	„	1	......	„	
1	„	„	1	......	Bar. 7·40.	Temps nuageux, la brise mollit graduellement, mer toujours excessivement grosse franchit la pompe 3 fois. Au jour commencé á passer les bras de misaine, puis relevé la cape et fait route au Nord sous la misaine et le grand foc B. A. Des petites grainasses de temps à autres. Passé les bras d'hune et de perroquet, envergué un basris sur la vergue du point volant et l'établi, dévergué le point perroquet. Pompe franche.
2	„	„	1	......	„	
3	„	„	1	......	„	
4	„	„	1	......	„	
5	„	„	1	......	Bar. 7·48	
6	„	„	1	......	„	
7	„	Nord	1	0	La	
8	„	„	1	......	mizaine	
9	„	„	1	......	Bar. 7·52	
10	„	„	1	......	Le	
11	„	„	1	......	pt. hunier	
12	„	„	1	......	„	
Latitude	...	...	...	...	... ...	19° 15′ Nord.
Longitude	...	...	...	...	... ...	89° 17′ Est.

DU MERCREDI 1 AU JEUDI 2 NOVEMBRE 1876.

1	N. O.	N.N.E.	3	...	Mizaine	Beau temps, petite brise variable, mer grosse, envergué le point perroquet ridi l'étai d'artimon les haubans, puis établi la brigantine. Pompe franche.
2	Vble.	„	3	......	pt. hunier,	
3	„	„	3	......	pt. perquett,	
4	„	„	3	......	gd. foc.	
5	„	Nord.	3	......	La	Même temps et même voilure que le quart precédent, fort roulis. Pompe franche.
6	„	„	3	......	brigantine.	
7	„	„	3	......	„	
8	„	„	3	......	„	
9	„	„	3	......	„	Même temps, vers 19 heures la brise fraîchit un peu, grosses houles du N.E. faisant rouler le navire. Pompe franche.
10	„	„	3	......	„	
11	„	„	3	......	„	
12	„	„	3	......	„	
1	„	N.N.E.	3	......	„	Même temps, la brise mollit, vers 2 heure cargué la brigantine par rapport aux roulis. Pompe franche.
2	„	„	3	......	„	
3	„	„	3	......	„	
4	„	„	3	......	„	
5	„	N.1-4N.E.	2	......	„	Même temps, au jour aperçu 3 navires courant comme nous et à contre bord, à 7h. envoyé la bordée dressé le lest, envergué le foc d'artimon. Pompe franche.
6	„	„	2	......	„	
7	„	„	2	......	„	
8	„	„	2	......	„	
9	„	E. 1-4 N.E.	3	......	Le	Méme temps, achevé de mettre le navire droit installé une draille du mât d'artimon au mât de mizaine et envergué dessus un foc d'artimon, monté les voiles de la soute. Pompe franche.
10	„	„	3	......	foc d'artimon.	
11	„	O.N.O. 1-2O.	3	......	„	
12	„	„	3	......	„	
Latitude	...	...	...	...	... ...	19° 55′ Nord.
Longitude	...	...	...	...	... ...	89° 38′ Est.

Log of the Ship "Tennyson," 1,281 *tons, from Rio Janeiro to Calcutta* (*cargo* 600 *stone ballast*).

Crossed the Equator 13th October in longitude 89°40′ E.; had light baffling winds (chiefly from westward), with heavy rain; thunder and lightning until 26th, when we were in latitude 13°0′ N., longitude 89° 35′ E.

The wind then veered to N.E., and the weather cleared up beautifully. Notwithstanding this, the barometer and aneroid, which had remained very steady since crossing the Equator (ranging daily between 30·10 and 30·00), now fell to 29·90 and 29·80.

27th October.—Wind N.E. and E.N.E. Fine steady breeze, with clear weather all day. A deal of lightning to the north-eastward during the night. Latitude at noon 15° 20′ N., longitude 89° 15′ E.; barometer ranging from 29·80 to 29·70, aneroid ranging from 29·85 to 29·75.

28th October.—The clouds at daybreak of this day had a bad appearance, being of a dull leaden color, which partly cleared away when the sun rose, and we had a fine steady breeze from N.E. to N.N.E. all day. Noon, latitude 17° 17′ N.; longitude 88° 20′ E.; barometer ranging between 29·80 and 29·70, aneroid ranging between 29·70 and 29·62. During the afternoon we began to experience a swell from the southward, slight at first, but getting heavier during the night. Heavy lightning was seen from N.E. and E. during the night.

29th October.—At 2 A.M. the wind, which had kept steady during the last two days, now veered to east, when heavy rain clouds began quickly to gather up, and from 3 A.M. until 7 A.M. had some smart squalls, from which time till noon the squalls took off, and we had a steady breeze from N.E. At noon our latitude by account was 18° 20′ N., and longitude 89° 18′ E. In the afternoon the weather began to have a very bad appearance, and heavy lightning was seen to the south-eastward, and the swell from the southward was rolling up heavy. The squalls now began to come down heavy, and the topgallant sails were taken in. The wind from 2 P.M. kept steady at E.S.E. until midnight; barometer ranging between 29·75 and 29·70, aneroid ranging between 29·70 and 29·65. Steering to N.N.E. since noon at the rate of 9 to 10 knots.

30th October.—Up to this time the barometer had fallen so little that I thought it might only be a strong southerly breeze down the Bay; but at 2 A.M. the swell began to get so heavy and the weather to have such a bad appearance, I stowed upper topsails and courses and stood down the Bay to the southward under lower topsails only; wind E.S.E. At 4 A.M. wind veered to east, and at 6 A.M. to E.N.E., and continued steady from this point during the rest of the day (force about 9). At 2 P.M. sent hands aloft to re-stow sails and put extra gaskets to make all secure. At 6 P.M., the sea being very heavy and the ship falling off the wind a good deal, the lower fore-topsail was taken in and fore-topmast staysail set instead, after which she laid very steady. At 10 P.M. the wind commenced to blow in furious gusts, and rained in torrents for an hour or so, and then fell suddenly calm for a few minutes, during which time the sea was tumbling in heaps from all sides. The topsails were now taken in, and ship laid under bare poles with head S.S.E. At 11 P.M. the cyclone burst on us from E.N.E. with a roar-like thunder, throwing the ship on her beam ends until the first rush was past, when she again righted.

BAROMETER READINGS THIS DAY.

Hour.	Barometer.	Aneroid.					
2 A.M.	29·80	29·74	Wind	E.S.E.	Force	...	7
4 „	29·80	29·74	„	„	„	...	8
8 „	29·84	29·76	„	„	„	...	8
10 „	29·85	29·77	„	E.	„	...	8

BAROMETER READINGS THIS DAY—(*Continued.*)

Hour.	Barometer.	Aneroid.					
Noon	29·78	29·70	Wind	E.N.E.	Force	...	8
4 P.M.	29·65	29·60	„	„	„	...	8
8 „	29·68	29·58	„	„	„	...	9
10 „	29·70	29·60	„	„	„	...	10
Midnight	29·60	29·45	„	„	„	...	11

No lightning seen or thunder heard during the whole of this day.

31*st October*.—From midnight till 9-30 A.M. the wind, which blew with hurricane force, kept steady at E.N.E., at which time it veered to N.E.; at 11 A.M. it veered to N.N.E., and at noon to north. Up to this time the ship had laid very quietly, as the sea was regular, though very heavy, but as soon as the wind veered to north, it was a perfect howl. The sails were now torn from the gaskets one after another and went to ribbons in a few minutes; the sea was a complete mass of confusion, and the ship lurched heavily to leeward, shifting the stone ballast and throwing her on her beam ends, after which she lay comparatively quiet; but the lee sea breaking on board swept away everything within reach and kept all hands baling water out of cabin and forecastle. This continued until 6 P.M., when it began to moderate, and at 8 P.M. had moderated sufficiently to enable us to set lower staysails to steady her; at midnight it had died away to a calm, leaving a heavy confused sea; found ship had a list of six feet to starboard.

No lightning was seen during this day. The following are barometer readings on this day:—

Hour.	Barometer.	Aneroid.					
2	29·55	29·40	Wind	E. N. E.	Force	...	12
7	29·35	29·20	„	„	„	...	12
8	29·25	29·10	„	„	„	...	12
9-30	29·10	28·95	„	N.E.	„	...	12
11	28·70	28·60	„	N.N.E.	„	...	12
12-30	28·25	28·15	„	N.	„	...	A complete howl.
1-30	28·15	28·00	„	N.N.W.	„	...	
3	28·60	28·45	„	N.W.	„	...	
4	28·85	29·00	„	„	„	...	
6	29·25	29·30	„	W.N.W.	„	...	
8	29·40	29·55	„	W.	„	...	9
10	29·60	29·70	„	W.N.W.	„	...	6
Midnight	29·80	29·80	„	W.N.W.	„	...	3

It rained all the first half of this day, but from noon till 6 P.M. no rain fell; but the top of the sea was blown along in a blinding manner, making it impossible to see 20 yards outside the ship: it was very painful on the eyes also, and made it difficult to keep them open.

1*st November*.—Light airs from W.N.W. to N., and beautiful clear weather all this day; sea quite smooth, no appearance whatever of the cyclone of yesterday. Noon.—Latitude 18° 54′ N., longitude by observations 89° 33′ E.; barometer ranging between 29·90 and 29·85; aneroid steady at 29·80 all day; no daily range.

From this time until anchoring in the river on 6th had light northerly winds with a strong W.S.W. current.

M. CORRANCE, *Master*.

Report of weather experienced in the Bay of Bengal from 27th October till 1st November 1876 by the ship "British Sceptre."

27th October.—Latitude 9° N., longitude 92° E.; wind S.W. to south; barometer 29·70, thermometer 80°. Strong breeze, deluge of rain. Passed a ship and barque under very low canvas. Expecting bad weather on account of season, and full moon coming on, carried on all possible sail to get north.

28th October.—Latitude 12°20′ N., longitude 92° E.; wind S. to S.E.; barometer 29·72, thermometer 80°. Torrents of rain; alternately cold and warm. In company with large ship very much like the *New York;* she is steering direct for Calcutta. I feel queer to see a ship running with a fair wind whilst I am nearly close hauled under low canvas, and queer remarks are made by all on board, yet I think I am right.

29th October.—Hard squalls, torrents of rain. A vessel on port quarter steering direct. Latitude 15° 8′ N., longitude 92° E.; wind S.E. to E.; barometer 29·70, thermometer 82°.

30th October.—Latitude 17°41′ N., longitude 91°50′ E.; wind E.S.E. to E.; barometer 29·70, thermometer 82°. At 4 P.M. hove to under lower fore and main topsail, main trysail; blowing very hard in squalls; barometer falling, 29·56. Very threatening appearance; moon showing with a reddish glare, tinging banks of clouds same color; wind S.E., with a high rolling swell from S.E. and S.; gale freshening in squalls, with torrents of rain, warm and cold; barometer oscillating between 29·55 and 29·50.

31st October.—4 A.M.—Blowing a very hard gale; tremendous sea on; ship heading N.E. on starboard tack; barometer 29·50. Lightning to S.S.W. in great glare, where I expect centre of cyclone to be travelling N.N.W. 10 A.M.—Tremendous squalls, blinding rain; split fore-topsail to rags. Noon.—Ship heading sea badly; paid out 90 fathoms of hawser with fenders chain attached over starboard; a great improvement, as the ship does not fall off so much. Noon.—Barometer 29·38; hard blow; hurricane blasts; rain coming down in sheets, hot and cold: you cannot see even masts. 4 P.M.—Barometer 29·28; furious squalls; split main topsail. 6 P.M.—Barometer 29·22. 8 P.M.—Shift of wind to S.; blowing harder than ever, wind one continuous roar; expect masts to go every moment; ship buried in the lee side under water; everything moveable washed off deck. 10 P.M.—Glass jumped up to 29·40; wind shift to S.S.W. Thank God! centre is passed. 11 P.M.—Still blowing hard, but a marked improvement; glass slowly rising. 4 A.M.—Barometer 29·60; wind moderate; sea moderating. Sounded in 55 fathoms of water. Longitude 90° 40′ E.; wind W. All hands repairing and bending sails. Find ship with strong list to port. Tarpaulin washed off main hatch; mastcoat of mainmast tore.

W. H. LABUKE, *Commander.*

Log of the Ship "Lady Octavia," from Sunderland to Calcutta.

Saturday, 28th October 1876 (civil time).—Latitude 18°5′N., longitude 89°25′E. Noon.—Light steady breeze and clear weather. 6 P.M.—Sky overcast; wind unsteady and increasing in gusts, accompanied with heavy showers and vivid lightning; wind veering between north-east round by east to south.

Sunday.—3 A.M.—Weather clearing and wind steady at east; set all plain sail. 10 A.M.—Heavy dark clouds gathering up from north-east and south; wind light and unsteady. 11 A.M. to noon.—Sharp squalls and heavy showers. Position by D.R. at noon, 19°33′ N., 90°14′ E. Noon to 6 P.M.—Heavy rain; winds variable in force and direction. At 3 P.M. a whirlwind passed close by the ship from E.N.E.

which formed into a waterspout some distance to leeward; a hard squall, followed with loud peals, of thunder and vivid lightning. 8 P.M.—Weather clearing; light passing showers until midnight.

Monday, 30*th October*.—Sky becoming dark and stormy-looking, sea beginning to rise. At 4 P.M. heavy squalls from north-east, backing to north-north-west; shortened sail to topsails. 8 A.M.—Wind lighter, but wild and dirty-looking weather, and sea increasing. At 9-30 A.M. a large ship crossed our bows, steering about west-north-west and carrying all plain sail. At about 11-30 A.M. saw that she had stranded, backed her yards and let fly light halyards. We starboarded our helm and stood off into deeper water; were then in six fathoms. Noon.—We began to clear away the starboard life-boat to send assistance to stranded vessel. 1 P.M.—Put round to stand it nearer the wreck and send away the boat, but not being able to pitch near, we squared away for the light-ship on the chance of speaking a steamer; but the weather rapidly becoming worse and the sea increasing, we again hauled to the wind to obtain a safe offing. 2 P.M.—The wreck not visible from the deck, but saw two other vessels apparently within sight of her. 6 P.M.—Close-reefed upper topsails and furled them, reefed the foresail and set it; sea increasing and confused; barometer jumping and falling rapidly. Midnight.—A hard gale from east-north-east, and steadily increasing; sea running high and very confused. Barometer 29·82, thermometer 81·5.

Tuesday, 31*st October*.—At 5 A.M. the fore-topmost staysail blew to pieces. 7 A.M.—Furled the foresail. 8 A.M.—Furled the close-reefed mizzen topsail and fore-topsail. Noon.—Ship hove to under lower main topsail, heading south-south-east; wind blowing with hurricane force and a fearfully high and cross sea running. 5 P.M.—The main topsail blew to pieces, having started the jackstay clogs from the yard right across before the canvas parted. At 5-15 P.M. the fore-topgallant mast parted at the cup; cut away the gear to save the other spars, but was scarcely on deck when away went the main, and after it the mizzen-topgallant mast, carrying away the topmast head by the shrouds; lee crojack and topsail braces gone and sails all blowing from the gaskets, main and main topsail braces carried away, fore and foretopsail braces carried away. Ship at 5-30 P.M. pressed down to lee rail, and nearly all the lee bulwark washed away; sea making a clean breach over her and sweeping away everything from the decks. It smashed in the front of the poop and cleared out the cabins, carrying away ship's chronometers, charts and papers, all the captain's clothing and property, and left nothing belonging to Mrs. Marshall and son but what they wore. The steward and the second and third mates lost everything, and the steward's store-rooms completely gutted out. The first mate was washed overboard and got his hand hurt among the lee wreck, the forefinger being cut off by the first joint; he was washed into the fore rigging, and had to cross over to windward by the top, and down the weather rigging. The top was then smashed all away, the yards tearing up everything they fetched against; wind then blowing with such force that it was nearly impossible to squeeze down between it and shrouds. About this time the lee side of deck-house was under water and the whole house gutted, with all the petty officers' and boys' clothing; the starboard side of forecastle and lockers also gutted out, and cook's galley the same; Captain's gig was carried away from davits, and one davit wrenched off from side; the starboard life-boat was also swept away from chocks, and the long-boat started from top of deck-house; all spare sails were swept out of sail lockers; boatswain's and carpenter's stores also gone, &c. At 7-30 P.M. the lightning began to flash very near, and soon the wind lulled a little and backed into north-west.

READINGS.

2 A.M.,	barometer	29·80,	thermometer	81·3
4 "	"	29·71	"	81·5
8 "	"	29·60	"	80·5
10 "	"	29·58	"	80·1
Noon	"	29·50	"	80·3

Barometer readings from noon in the margin. At about 6 P.M. the barometer got broken and glass of aneroid cracked; all the meteorological instruments and books broken up and washed away. At 8 P.M. gale moderating and sea going down; ship righted to about three feet list; four feet six inches of water in main hold; cleared away the wreck and manned the pumps.

3	P.M.,	barometer	... 29·10
3-30	"	"	... 28·90
4	"	"	... 28·46
4-30	"	"	... 28·25
5-30	"	"	... 28·15

Wednesday, 1*st November.*—Daylight, fine and clear weather; two vessels in sight; sea still high, but going down fast. Noon, calm and clear weather.

Thursday.—At 2 P.M. launched starboard life-boat and pulled towards a dismasted ship, to get, if possible, some sails and a chronometer. She proved to be the ship *British Statesman* from Liverpool with only mizzen-mast standing and crojack set; her bulwarks gone all along starboard side, and cabins, cuddy, and forecastle gutted out, and had lost one man overboard. They were rigging a jury foremast and clearing up wreck. Captain Sexton gave me a chronometer, a foresail, mainsail, and lower topsail, and some steward's stores.

Abstract Log of the S. S. "Japan," from London towards Calcutta viâ *the Suez Canal.*

H.	K.	F.	Courses.	Winds.	Bar.	Remarks.—Saturday, 28th October 1876.
1	9	......	N. 55 E.	N.W.	......	1 A.M.—Course, north-east by Pole. At 2-15 Great Basses abeam. 4 A.M.—Light variable winds and cloudy weather.
2	9					
3	9					
4	9	......	......	North.		
5	9	......	......	......	......	5 A.M.—Little Basses ahead; set course by Pole north-north-east; set all square canvas.
6	9	......	N.N.E.	Westerly.		
7	9	......	......	"		
8	9	......	......	"	......	8 A.M.—Light breezes and fine.
9	8	4	......	"		
10	8	4	......	"	......	10 A.M.—Light wind and weather.
11	8	4	......	"		
12	8	4	......	"	......	Noon.—Ditto ditto.

Latitude.			Longitude.	Course.	Barometer.	Distance.	Variation, Current.
Acct. Obs.	6° 57′ N. 7° 4′	....	82·21E. 82·12E.	....		184 miles. 196 "	Current var. 4′12E.

H.	K.	F.	Courses.	Winds.	Bar.	Remarks.
1	8	4	N.N.E.	Westerly.	......	3 P.M.—Squally weather; took in all square canvas.
2	8	4				
3	8	4	......	......	......	4 P.M.—Squally wind and weather.
4	8	4				
5	8	4	......	......	......	Sunset.—Squally and cloudy weather.
6	8	6				
7	9					
8	9	......	......	......	......	8 P.M.—Light breeze and cloudy; squally weather with light rain.
9	9					
10	9					
11	9					
12	9	......	......	......	......	Wind and weather squally throughout the watch.

Abstract Log of the S. S. "Japan," from London towards Calcutta viâ *the Suez Canal*—(Continued).

H.	K.	F.	Course.	Winds.	Bar.	REMARKS.—Sunday, 29th October 1876.
1	9	......	N.N.E.	West.	......	1 A.M.—Squally, with heavy rain throughout.
2	9					
3	9	......	......	......	......	1-30 A.M.—Heavy squall from the westward, with rain.
4	9					
5	8	......	......	......	......	4 A.M.—Squally.
6	8	......	......	......	......	Daylight.—Strong breeze and cloudy weather; set all fore and aft sail.
7	8					
8	8					
9	9	4	......	W.N.W.	......	8 A.M.—Strong breeze and cloudy weather.
10	9	4				
11	10	1	......	......	......	12.—Fresh breeze and squally throughout the watch.
12	10					

Latitude.			Longitude.	Distance.	Barometer.	Current.	Variation Currents.
Obs.	9·53 N.	......	83·48 E.	194 miles.		N. 29 E.	4° E. by S., 21 miles.
Acct.	10·14 N.	......	83·47 E.	211 „		N. 26 E.	

H.	K.	F.	Course.	Winds.	Bar.	Remarks.
1	8	4	N.N.E.	W.N.W.	......	P.M.—Strong wind; heavy north-west swell; in first reef, in fore-topsail, and main-trysail. 4 P.M.—Strong wind and weather.
2	8	4				
3	8					
4	8					
5	8					
6	8	......	......	......	......	Sunset.—Fresh gale and cloudy, with a very unsettled appearance; secured everything about the deck; furled the foresail and reefed fore-trysail. 8 P.M.—Moderate gale, with high sea and squally weather; lightning from north to north-west, with a heavy bank of clouds to the northward; every appearance of a gale; barometer falling.
7	8					
8	8	......	......	......	29·88	
9	8					
10	8					
11	8					
12	8	......	......	......	29·80	

Abstract Log of the S. S. "Japan," from London towards Calcutta viâ *the Suez Canal*—(Continued).

H.	K.	F.	Course.	Winds.	Bar.	Remarks.—Monday, 30th October 1876.
1	8	......	N.N.E.	W.N.W.	29·80	A. M.—Moderate gale, with heavy rain and squalls throughout, and a heavy confused sea; ship rolling and lurching very heavily, and taking large quantities of water over all. 4 A.M.—Ditto wind and weather. 6 A.M.—Furled fore-topsail, close reefed. 7 A.M.—Freshening gale with heavy confused sea; ship labouring heavily; eased engines down to dead slow; a very heavy bank forming to N. and N.E., with rain and squalls: 8 A.M.—Fresh gale and cloudy, with heavy sea; heavy squalls passing, with rain; decks awash fore and aft.
2	8					
3	8					
4	8					
5	8					
6	7	4				
7	4	4				
8	4	4	......	......	29·75	
9	4					
10	3	......	N. by W.			
11	4	......	......	......		
12	3		Leeway 11½ points.	......	29·70	12 o'clock.—Fresh gale, squally, with heavy sea; engines going dead slow.

Latitude.		Longitude.		Barometer.	Distance.	Variation.	Current.
Obs. Acct.	12·9 N. 12·28 N.	85·30 E. 85·10 E.			170 miles. 170 „	4° East.	South 57 E., 35 miles.

1	2	4	N. by W.	N. W. by W.	29·65	4 P.M.—Ship making 2 points leeway. Heavy squalls and showery weather; all fore and aft sails set, with a single reef in each; ship taking great quantities of water over all. 5·30 A.M.—Altered the course north-by-east ½ east; engines half-speed; set close reef fore-topsail. 6-20 A.M.—Gale moderating; engines on full speed. 8 P.M.—Strong gale, with a heavy sea on; ship labouring heavily; squally, with heavy gusts and rain. 10 P.M.—Fresh breeze, and fine overhead; sea going down.
2	2	4				
3	2	4				
4	2	4				
5	3	4				
6	2	4	N.byE½E.	......	29·70	
7	3	4				
8	8	4				
9	7	4				
10	7	4				
11	7	4				
12	7	4	......	......	29·75	

Abstract Log of the S. S. "Japan," from London towards Calcutta viâ the Suez Canal—(Continued).

H.	K.	F.	Course.	Winds.	Bar.	Remarks.—Tuesday, the 31st October 1876.
1	8	......	N.byE.½E.	West.	29·80	A.M.—Fresh breeze and squally weather.
2	8					
3	8					
4	8					
5	8	......	......	......	29·82	Moderating breeze and sea; out second reef fore-topsail; weather squally. 7-30.—Out all reef try-sails and set jib. 8 A.M.—Weather cloudy.
6	8					
7	8	......	......	......	......	Noon.—Ditto wind and weather.
8	8					
9	8					
10	8					
11	8					
12	8					

	Latitude.	Longitude.		Barometer.	Distance.	Variation.	Current.
Obs. Acct.	14·22N. 14·37N.	86·38E. 86·21E.			149 miles. 156 „	4° East	S. 50° E. Distance 23 miles.

H.	K.	F.	Course.	Winds.	Bar.	Remarks.
1	8	4	N. 14° E.	Westerly	......	At 1 P.M., out first reef fore-topsail; moderate breeze and cloudy, with a heavy westerly swell.
2	9					
3	8	6				
4	8	6				
5	8	4	......	......	......	At 4 ditto wind and weather. Sunset.—Moderate breeze and fine, with a long north-west swell on. 8 P.M.—Moderate and fine; long north-west swell; all plain sail set.
6	8	4				
7	8	4				
8	8	4	......	......	29·83	
9	8					
10	8	......	N. 12 E.			
11	8	......	......	......	......	
12	8	......	......	......	......	

Abstract Log of the S. S. "Japan," from London towards Calcutta viâ the Suez Canal—(Continued).

H.	K.	F.	Course.	Winds.	Bar.	Remarks.—Wednesday, the 1st November 1876.
1	8	......	N. 12° E.	West	......	A.M.—Fresh breezes and hazy, with a heavy northerly swell.
2	8					
3	8					
4	8					
5	8					
6	7	6				
7	7	6				
8	8	......	......	......	......	8 A.M.—Light breeze and fine, with a heavy northerly and north-west swell on.
9	8					
10	8					
11	8	......	......	......	......	10 A.M.— Ditto ditto ditto.
12	8	......	......	......	......	Noon.—Light breezes and fine clear weather.

Latitude.			Longitude.		Barometer.	Distance.	Variation.	Current.
Obs. Acct.	16·51N. 17·10N.		87-11E. 87-38E.			150 miles. 197 ,,	4°E.	S. 27 W. 44 miles.

H.	K.	F.	Course.	Winds.	Bar.	Remarks.
1	8	......	N. 18 E.	W. N. W.		
2	4					
3	4	......	......	......	......	4 P.M.—Light breezes and cloudy, with a ship in company standing to the northward.
4	4					
5	4					
6	4	......	......	......	......	
7	4					
8	4	......	......	......	......	8 P.M.—Light breeze and fine clear weather.
9	5					
10	5					
11	8	4				
12	8	6	......	......	......	Light airs.

Abstract Log of the S. S. "Japan," from London towards Calcutta viâ *the Suez Canal*—(Concluded).

H.	K.	F.	Course.	Winds.	Bar.	Remarks.—Thursday, the 2nd November 1876.
1	8	4	N. 18° E.	Calms	......	A.M.—Calms and fine clear weather.
2	8	4	......	......	......	4 A.M.—Ditto wind and weather.
3	8	4	......	......	......	Daylight.—Light breeze and fine, pleasant, clear weather.
4	8	4				
5	8	4	......	......	......	6 A.M.—Spoke the ship *Scottish Chieftain*, dismasted on Tuesday in a cyclone off the Sandheads.
6	8	4				
7	6	4				
8	8	4	......	......	......	8 A.M.—Light breeze and fine.
9	8	4	......	......	......	9-30 A.M.—Spoke verbally the *Sand Scofield*, who reported having seen a vessel with only lower mainmast standing. Ship *Ghazeepore* in latitude 19·5 N., longitude 88·12 E., at noon of the 1st. bearing S.W.
10	8	4	N. 12° E.			
11	8	4	N. 10° E.			
12	8	4	N. 10° E.			

Latitude.			Longitude.		Barometer.	Distance.	Variation.	Current.
Obs. Acct.	19·20 N.		88·5 E.	E.		159 miles.	4° 14 E.	S. W. by S. 12 miles.

1	8	......	N. 5° E.	North	......	Light northerly winds and fine clear weather.
2	8	......	,,			
3	8	......	,,			
4	8	......	,,	......	......	3 P.M.—Bore away N.N.E. to speak a dismasted ship.
5	......	......	N. N. E.			
6	......	......	N. 7° E.	......	......	5 P.M.—Passed a large iron ship with mainmast and mizzen-topmast gone.
7						
8						
9						
10	......	......	N. 10° E.			
11	......	......	......			
12	......	......	North	......	......	Light breeze and fine weather.

H. DeSmidt, *S. S. Japan.*

Abstract Log of the Ship "Allahabad," from Melbourne to Calcutta—October and November 1876.

Saturday, 28th October 1876.—Latitude 12° 4′ N., longitude 91° 0′ E.; barometer 29·70, thermometer 79; wind S.S.E. to S.; constant rain. No observation of the sun; under lower topsail; weather threatening; heavy squalls, but the barometer is steady. Many land birds flying into the saloon. Fitted canvas covers for ventilators.

Sunday, 29th October 1876.—Latitude 14° 53′ N., longitude 92° 10′ E.; barometer 29·70, thermometer 81; strong S.E. wind; constant rain and very heavy squalls. When the sun rose all the clouds were of a brick-dust appearance, and a heavy bank of clouds to the southward, blue color and very dark. Lightning to the E. and N.E., and a very heavy swell from S.W. I am of opinion that there is a cyclone coming up from the southward; under low canvas; found a strong current setting northward.

Monday, 30th October 1876.—Latitude 17° 57′ N., longitude 91°40′ E.; barometer 29·70, thermometer 80; wind S. to E.; constant rain; very heavy squalls; barometer inclined to fall; a very heavy swell from S.S.W. and S.W.; large heavy clouds coming up from southward. 8 P.M.—Weather looking bad and threatening, with every indication of a cyclone. I hove the ship to the wind on the starboard tack under lower main-topsail and mizzen-staysail. 9-30 P.M.—Split lower main-topsail in a heavy squall; the ship is now under mizzen-staysail, and canvas in the mizzen-rigging; sea getting heavier; battened down the ventilators. 11 P.M.—Blowing a heavy gale from E.S.E.; battened main hatch down; found a strong current setting northward.

Tuesday, 31st October 1876.—Latitude 19° 10′ N., longitude 90° 48′ E. by account; barometer 29·67, thermometer 80. Midnight.—Blowing a very hard gale from E.S.E.; heavy sea from E.S.E. and the S.S.W. sea getting worse. I am quite convinced now that there is a cyclone coming up from the southward. Lightning to the southward, constant rain, and very heavy squalls. 4 A.M.—Squalls heavier. 10 A.M.—Hauled down mizzen-staysail, wind blowing in such heavy squalls. Noon.—Heavier gusts of wind; shipping heavy lee water; had to batten down fore and after hatches; barometer falling fast now. Cyclone commenced with fury. Barometer at noon this day, 29·45; 2 P.M., 29·30; 4 P.M., 29·20; 6 P.M., 29·10; 8 P.M., 28·90; 10 P.M., 28·90; midnight, 29·20. From noon this day to midnight the cyclone raged with great fury, constant rain and flashes of lightning. 8 P.M.—Wind commenced to veer to the S.E. 10 P.M.—Wind S.S.E. to S. This is the heaviest part of the cyclone; blowing with inconceivable fury; sails torn from their gaskets; the canvas in the mizzen-rigging blown away. 11 P.M.—Lightning, but could not say in what direction.

Wednesday, 1st November 1876.—Latitude 20° 13′ N., longitude 91° 40′ E.; barometer 29·20, thermometer 79; wind S.S.W; wind not so heavy; centre of cyclone passed. 1 A.M.—Wind W.S.W., moderating fast; set mizzen-staysail, fore-topmast staysail, also foresail; barometer rising fast. 8 A.M.—Setting what sails we had to steady the ship from rolling; sea going down; hurricane over; sea going down fast. Noon on Wednesday, weather fine. The barometer had risen to 29·80. Fine weather after this to Calcutta. I consider the centre of cyclone passed west of the position of ship about 10 P.M. to 11 P.M. on Tuesday night, and not far away, travelling northward. I experienced a strong current to the N.E. during the cyclone on Tuesday.

JOHN WESTCOTT,
Master, Ship "Allahabad."

Abstract Log of the Ship "Forfarshire."

I herein furnish you with extract of my log in connection with the late cyclone. 25th October.—Latitude 11° 30′ N., longitude 90° 30′ E.; at noon barometer 29·85; weather clear, and N.E. monsoon set in. Weather continued fine until 28th October; the weather then became squally and unsettled, with thunder, lightning, and rain; wind veering from N.E. to E. and S.E.; reduced sail to lower topsail. At noon latitude 18° 30′ N., longitude 88° 23′ E.; barometer 29·80. 29th October.—After midnight of 28th weather still the same; towards sunrise sky clearing to N.E.; weather became fine; set sail; wind easterly. Forenoon.—Threatening appearance to S.E.; strong southerly swell; wind increasing; shortened sail. Throughout the remainder of the day weather squally and unsettled, with rain. October 30th.—Strong gale, with heavy squalls during the early part of the day; wind from E. to S.E. Noon.—More moderate and steady; latitude 20° 19′ N., longitude 88° 55′ E.; barometer 29·75. At 4 P.M. strong squalls with rain; Eastern Channel Light-ship N.N.W., 27 miles; waves to southward: every appearance of an approaching cyclone; ship under reefed topsails and reefed foresail; shortened sail as the gale freshened. At midnight ship under lower fore and main-topsails and fore-topmast staysail on the port tack; barometer 29·60, and falling steadily; wind N.E. by E. 31st October.—Gale increasing, with heavy squalls; wind N.E.; heavy sea coming from southward. At 3 A.M. blowing heavy, with squalls; took in the lower fore-topsail and fore-topmast staysail. At 11-30 A.M. blowing with great fury; took in the lower main-topsail and laid to under bare poles; sea running very high. At noon barometer 29·20; latitude by account 19° 30′ N., longitude 88° 30′ E. Between 4 and 5 P.M. barometer 28·40; centre passing close to eastward of the ship. Cyclone raging with its utmost fury, blowing away the three topgallant masts, fore-topmast by the cap, taking jibboom along with it; sails out of the gaskets. About 5 P.M. wind veering rapidly to northward; weather moderating, and barometer rising rapidly towards midnight. November 1st.—Weather fine and wind light from W. to S.W.; barometer at noon 29·80. My barometer *might* have been lower during the passage of the centres; I have given the lowest reading I observed.

D. D. BROWN,
Ship "Forfarshire."

Extract Log of the Ship "Lightning."

SUNDAY, 29TH OCTOBER 1876.

1st Part—

1 to 8 P.M., Saturday afternoon.—Rate of sailing 5½ knots; barometer 30·00; wind N.E. to E.N.E.

P.M.—Tacked ship to the eastward. Fresh breeze rather dull; all sail set by the wind.

2nd Part—

8 P.M. to 4 A.M., Sunday morning.—Rate 5 and 4 knots; wind variable, north-easterly.

Midnight.—Variable wind and cloudy; in all small sails; squally, unsettled.

3rd Part—

4 A.M. to noon.—5, 6, and 7 knots; wind unsteady, E.N.E.; latitude observed 19° 42′ north, longitude by chronometer 89° 23′ east.

8 A.M.—Fresh breeze and cloudy; all sail set by the wind. Noon.—Fresh breeze westward; barometer 29·94; no work done, being the Sabbath; pump well attended to, making no water.

MONDAY, 30TH OCTOBER 1876.

Begins at noon, Sunday.

1st Part—

Noon to 8 P.M., Sunday evening.—Rate 6 to 7 knots; wind E.N.E.

P.M.—Strong breeze and dull. 8. P.M.—Squally, strong breeze; all small sails in.

2nd Part—

8 P.M. to 4 A.M., Monday morning.

10 P.M.—The Eastern Light-ship hove in sight N. by. E. about 15 miles; sounded 40 fathoms.

3rd Part—

Three knots and less; wind variable, baffling and calm. Monday ends.

Noon.—Latitude 20° 40′ north, longitude 88° 35′ east.

Noon.—Strong gale and thick westers.

Barometer 29·90.

Midnight.—Light variable airs and calm; ship under short sails; the lead kept going; light-ship bore N.N.E., 15 miles; barometer 29·95. 4 A.M.—Fresh breeze, heavy squalls, and rain. 4 A.M. to daylight.—Dodging under easy sail; had a cast, 18 fathoms; light-ship bore N.E. by E. 6 A.M.—Lost sight of light-ship, E.N.E., about 20 miles. 8 A.M.—Had a cast of the lead, 10 fathoms, hard ground; weather continues unsettled; stood out to the S.E. under easy sail.

TUESDAY, 31ST OCTOBER 1876.

1st Part—

Noon to 8 P.M. of Monday.—Rate 3 knots; wind E.N.E., unsteady; ship's head S.E. to S.E. by E.; barometer 29·80, thermometer 80.

P.M., Monday afternoon.—Strong gale and hazy; shipping water over all. 4 P.M.—Gale still increasing; in foresail. 6 P.M.—Still increasing. 8 P.M.—In upper topsails.

2nd Part—

8 P.M. to midnight and 4 A.M.—Rate 1 to 3 knots; head S.E.; winds E.N.E., unsteady; leeway 5 points.

Midnight.—Strong gale; hazy weather; barometer 29·80; squally; put on extra gaskets where needed.

3rd Part—

4 A.M. to noon of Tuesday.—Rate 3 knots; head S.E.; wind E.N.E.; leeway 8 points; latitude 19° 46′ north, longitude 88° 31′ east. Noon.—Barometer 29·20.

4 A.M.—Strong gale, heavy sea, crossed by a very heavy swell from the south; stowed lower mizzen-topsail; shipping water over all. Barometer 29·60.

8 A.M.—Gale still increasing; in foretopsail, foretop main-skysail, and main-topsail carried away on taking in. Noon.—In mizzen-staysail; split on hauling down; set a tarpaulin in the mizzen-rigging; sea washing over all. Pump well and carefully attended to; ship making no water.

One man disabled by a sea.

WEDNESDAY, 1ST NOVEMBER 1876.

1st Part—

Noon, 8 P.M. of Tuesday, civil time.—Rate 3 knots; head up E. by S. off S.E. by S.; wind N.E.; leeway 8 points.

2nd Part—

8 P.M. to 4 A.M. of Wednesday.—Rate 3 knots; head N.E. by N.; wind veered to N.N.E. ¼ of hour; N. and N.N.W. by 8 P.M.

3rd Part—

4 A.M. to noon.—Rate 3 knots; head N. by E.

	Barometer and	*Thermometer.*
Noon	29·20	80
2 P.M.	29·10	80
3-30 P.M.	28·95	80
4 P.M.	29·05	80
6 „	29·30	80
8 „	29·45	80
Midnight	29·60	80
4 A.M., Nov. 1st	29·75	80
8 „ „	29·90	81
Noon „	29·99	81½

Latitude observed 19°41′, longitude D.R. 89° 3′

Remarks.—Tuesday.—Strong gale and heavy sea; shipping water over all; shipped a sea over starboard lee quarter, filling the starboard life-boat, carrying away tackles, lashing, and spars for gripes; cut away remains, not being able to save it; at the same time upper mizzen-topsail broke adrift from the yard, leaving only broken rope, also spanker.

2 P.M. to 4 P.M.—Port life-boat davit broke, tackles and lashings; cut away that boat also to prevent further damage. Captain Piton, assisting to clear away this boat, was knocked down and severely injured. Mainsail, mizzen-topgallant sail was also blown away at this time.

6 P.M.—Still heavy rain; wind blew away lower fore-topsail and carried away two shrouds of mizzen-rigging and starboard top-gallant bulwarks, and doing more or less damage about the decks and bulwarks.

8 P.M.—More moderate; sudden shift to N.W.; set three lower staysails.

Midnight.—Still moderating; set foresail.

4 A.M.—Still moderating; set upper fore and main-topsails, lower topsails having been blown away; mizzen royal bunk blown away last night.

8 A.M.—Fine weather; sea nearly smooth, with streaks of currents; all possible sail set.

I find many other occurrences of changes in the weather and behaviour of the ship during the heaviest of the cyclone, and before and after, not noticed in the mate's log, but believe the direction of the wind, ship head, and rate of sailing, with changes of the barometer, are correct.

J. E. PITON, *Master*.

Additional Remarks on board the Ship "Lightning," from Adelaide to Calcutta.

September 10th, 1876.—Sailed from Port Adelaide.

October 12th.—Crossed the Equator in longitude 88¼° E. From the Equator to latitude 9° 17′ N., off the Car-Nicobar Island, experienced very light winds and calms, with showers of rain and hot, sultry weather; sun very hot; ship making very little progress, 30 to 60 miles a day. Every evening saw heavy cumulus clouds in the direction of the islands, and much lightning. Remarked to the officers that it was in such weather that hurricanes brewed up, and that I would not be surprised if one would not follow us up. Thunder and lightning, long S.W. swell.

23rd October, Monday.—Latitude 9° 17′ N., longitude 91° 47′ E. This was our smallest day's work, 28 miles. Sun very hot, boiling the pitch out of the seams of the deck. 1 P.M.—Tacked N.N.W.; weather fine and clear; on the eastern horizon appearance of a light easterly monsoon. As night comes on our little monsoon freshens and veers aft E. by S. A dark threatening appearance north-eastward, with lightning rising and crossing the bow; generally black cumulus clouds hanging over the islands, which gave us lightning every evening.

27th October, Friday.—These last four days light N.E. to E.N.E. monsoon and fine weather to windward, but there is that disagreeable-looking cumulus nimbus (indications of a storm) cloud rising in the S.E. quarter every evening, with much lightning threatening us in an archway up to about 40 degrees, then crossing over to the S.W., across our stern, which gives an uneasy feeling, but hoping to get up to Calcutta before the storm comes on.

October 28th.—Latitude 18° 39′ N., longitude 89° 32′ E.

October 29th.—Latitude 19° 38′ N., longitude 89° 18′ E. Ship heading N. by W.; light easterly and unsteady monsoon; still that disagreeable nimbus and lightning making its appearance on our quarter in the S.E. and going across the stern. 9 P.M.—Having run 60 miles, sounded in 40 fathoms blue mud; directly after saw a light-ship N. by E., 15 miles; steered for it.

October 29th, Sunday, 10 P.M.—Steering for the light-ship; wind, S.E.; going 4 knots. Mutlah light-ship N.N.E., distant 15 miles. Wind became variable and calm. 1 A.M.—Sounded in 28 fathoms.

October 30th, 3 A.M.—Sprung up a light breeze from N.N.E.; standing on port tack. 4 A.M.—Light-ship N.N.E.; tacked north-westward. Weather becoming overcast and hazy; ship under easy sail; fore-topgallant sail clewed up, hanging loose, also mainsail. Weather has a forbidding appearance, but as the glass keeps up the same, 29·90, and the weather had given us the same appearance for the last three or four days, then clearing up fine, do not expect any bad weather. Saw a ship north of us on port tack. 5 A.M.—Light bore N.E. by E., true; baffling winds. 6 A.M.—Sounded in 16 fathoms, hard ground. Took aback by a N.E. squall and rain; trim yards on starboard tack. A ship one mile north of us run down and spoke us; kept too far off; could not make her out, but thought she was the *Annie Fleming* of Greenock. Understood the Captain to say he had been on the ground. 8. A.M.—After standing towards the sea reefs, sounded in 10 fathoms; wore ship to the S.E; wind E.N.E.; stowed fore-topgallant sail and mainsail.

October 30th.—Light-ship out of sight; no pilots in view. Ship from the southward, jack flying, put about and followed us south-eastward; like us, giving it up in despair to find a pilot. With this threatening weather think it advisable and prudent to stand out to sea.

Noon.—A glimpse of the sun gave latitude 20° 46′ N. Barometer 29·90, thermometer 82.

3 P.M.—Barometer 29·80; confused sea; stowed one foresail head, reaching under three topsails. Sunset.—*Annie Fleming* 5 miles S.W. of us. 8 P.M.—Barometer 29·80; in upper topsails; weather thick, overcast, unsettled appearance; heavy sea rising from lee bow southward; ship plunging into it; barometer 29·70. 10 P.M.—Cleared up for an hour, bringing up S. E. Midnight.—Barometer 29·68; rain again from south-eastward; wind at N.E. by E; ship heading from E. by S. to S.E by E.; 5 points leeway.

October 31st, Tuesday.—4 A.M.—Thick rain; blowing harder; heavy sea increasing; barometer 29·60, thermometer 82; stowed lower mizzen-topsail. 8 A.M.—Wind still at N.E. by E., blowing hard and rain; barometer 29·50; stowed fore-topsail, fore-top main-topsail and weather clew of main-topsail; nothing left set, but lee clew goosewing; set mizzen-staysail. 9½ A.M.—Bunt of main topsail gave way; clewed up the goosewing and stowed the remnant; blowing very hard, with small blinding rain; wind at N.E. by E.; barometer 29·50. Crew employed putting extra lashings on boats, &c. 10 A.M.—Tack of mizzen-staysail gave way, hauled it down, put it to rights; ship begins to pitch and lurch over heavily, taking whole green seas over lee mainsail, filling the decks; put relieving tackles on tiller. Last evening it had been my intention to put ship on starboard tack, but under existing circumstances thought her better on port tack, for land and sea room. Noon.—Barometer 29·20; fearful sea from the southward, double as heavy as that caused by the wind, which is broken by a cross sea from S.E., so we have three cross seas to contend with—N.E. by E.S.E., and southward. Good job ship is in good ballast trim; if deep laden, she must have filled her decks and swept it, as sometimes the heavy southerly sea came in on board almost from her beam, when ship came up to the wind, then fell off to head into it. Shipped a green sea over weather bow and washed off a skylight from deck-house, which was also started, and made the deck leak; barometer 29·20, thermometer 80°. Sym. 29·40, always three or four-tenths higher than the barometer, but now less. Wet and dry bulb thermometer lurched away and broke. Last entry, 30th, 9 A.M.—Wet bulb, 79°, dry 80°. At 1 P.M., while at dinner, ship took a heavy lurch over to leeward, lee quarter boat struck the sea, stove in starboard bow, and got adrift; made attempts to secure it and save the boat, but it broke in two; obliged to cut the remainder away. The weather-boat also bent and broke its davits inward and got loose in its fastening. Put a tarpaulin in the weather mizzen-rigging, which stood only a short time, when it was blown away. Ship laying to under bare poles, heading E. by S. to S.E., sometimes off to S.E. by S., 6 or 7 points leeway; nearly two knots. At 3-30 P.M. barometer 28·95, the thermometer 80°. Blowing furiously, impossible to stand against the wind; rains like a fire-pump hose, blinding and overpowering; sails blowing away from the yards. Men refused to go aloft to pass extra gaskets, neither could they go. The atmosphere a perfect foggy foam; men can do nothing but hold on for self-protection.

3-30 P.M.—Ship trembling like a leaf; fearful noise, with the wind howling and sea washing about the decks, rushing in the fore part of the poop, the cuddy door of which the carpenter had attempted to canvas and batten down; hands baling water out. 4 P.M.—Glass 28·95, and still inclined to fall. Went on deck, saw the port quarter-boat turning over on its davits; went to assist to secure it and see if it could be saved. In the act of doing so, a gust of wind lifted me up about ten feet above the deck, with a loose rope in my hand, when I fell plump on the deck and rolled over to leeward, and nearly overboard; was carried below senseless by the second mate and carpenter, who used restoratives. On coming to in my cabin deck found two cuts on forehead; collar-bone, one arm, and one foot severely injured. Requested the officer of the watch to cut away the boat if it could not be saved, the davit being broke, and only the force of the wind blowing and glueing over the boat to ship's donkey rail. Half an hour after I felt the weather must be moderating, as ship was easier. Worst of storm over.

6 P.M.—Barometer rising, 29·10, and sea going down very fast; wind inclined to northward. Never before have seen such a furious gale and such high confused sea going down so quick, and barometer rising. 7 P.M.—It was 29·40; it rose one tenth and a half per hour. 8 P.M.—Barometer 29·50; still blowing hard; sudden shift to north-west; set mizzen, main, and fore-topmast staysails. Midnight.—Barometer 29·70; still moderating. Requested officer of the watch to make sail.

1st November, Wednesday, 4 A.M.—Barometer 29·80. Found no other sail set; on inquiring reason, was told they were blown away. Tried foresail and upper main-topsail and set them. Daylight.—Quite moderate, sea smooth; loose all sails; all in ribbons at the mizzen, mainsail, lower main-topsail and fore-topsail; set gibs and what other sails we could. 8 A.M.—Light three-knots breeze at north-west; cloudy weather. Saw three other large ships, all appearing to have lost spars more or less. We seem to have suffered least: only two main shrouds gone, and lots of running gear and mizzen-royal truck blown off.

Noon.—Got observations: latitude 19° 40′ N., longitude 87° 30′ E., finding our position about 90 miles more to the S.W. than I expected; for I feared that the storm-wave, coming up in that fearful heavy sea southerly swell we had, would have set us to the northward, but we find we were fairly set to leeward, as the wind blew from north-eastward.

J. E. PITON, *Master.*

Extract from the Official Log of S. S. "Penang."

LEFT Calcutta at 5-30 A.M. of the 28th ultimo. Discharged pilot at 8 P.M. and proceeded.

Sunday, 29th.—Moderate N.E. wind, freshening after dark, with gloomy appearance. Midnight.—Wind still increasing and sea rising rapidly.

Monday, 30th, 2-30 A.M.—Ship running heavily and taking large quantities of water on board. Took in square sails, and hove to under balanced reefed fore-trysail, and tarpaulins in mizzen-rigging (the fore-staysail being blown away); slowed engines. Ship heading E. to E.S.E., but making no headway; barometer 29·50, falling, and every appearance of an approaching cyclone. 6 A.M.—Sea increasing; port life-boat broke adrift, and while securing this, the starboard cutter smashed and washed away; wind inclined to haul to the northward. 6 P.M.—Wind still increasing and taking large seas on board; deck midship house and port saloon door stove in; barometer 29·38. 8 P.M.—Ship heading N.E. by E., but drifting to the S.W.; starboard saloon door stove in; saloon full of water; seven lascars more or less injured while securing wreckage about the deck; barometer 29·35, and still falling. 10 P.M.—Ship heading N.E.; wind and sea increasing. Engineers and engine-room crew battened down below; all available deck crew employed freeing saloon of water; fore and main rooms and mizzen gaff blown adrift; poop and foredeck awnings partly saved.

Tuesday, 31*st*, 4 A.M.—Wind and sea increasing; gig washed away; glass still falling, 29·32; ship heading N.N.E. Wind and sea at its highest, impossible to walk or stand on deck. 7-30 A.M.—The whole of the front of the saloon stove in; ship laying like a log, with saloon full of water. All the head-boards, knees, &c., also gangways, washed away. All pumps kept going down below, and with difficulty fires kept in and steam up; part of fore-staysail only remaining, and tarpaulins in mizzen rigging; barometer 29·32. Took a couple of awnings and what wood procurable and blocked up front of poop and skylights. From this time the glass rising slowly, and wind evidently moderating. Noon.—Heavy water coming on board; all hands employed clearing saloon of water; wind more moderate, but with very heavy squalls; barometer 29·40. Glass rising, and wind and sea moderating all night.

Wednesday, November 1*st*.—Ship a perfect wreck on deck; part of crew disabled, remainder quite exhausted. Commander's cabin gutted; charts, books, and chronometers lost or spoiled.

Resolved to put back to Calcutta, knowing much water must have gone below. Steered for the position of the pilot station, and fell in with the pilot-vessel *Coleroon* about 40 miles off her station. Received pilot, and proceeded. Position by D. R. at worst of cyclone 17° 30′ N., 86° 50′ E.

Report of CAPTAIN JAMES JOPP, *of the Ship "Annie Fleming," dated Calcutta, the 27th November* 1876.

ON 29th October I came up with the light-ship at 10 P.M., the weather looking very unsettled. I have two good marine barometers on board. Barometers very unsteady; a heavy swell rolling in from the southward. I cruised about light-ship till 8 A.M. 30th.—Barometers rising up to 29·60, and in a few minutes down to 29·50; wind E.N.E. and light, with small rain; swell increasing; and as I could find no pilots up till 8 A.M., I put ship's head to the south-eastward. I then stood on a south-easterly course under whole topsails and whole courses, jib and main-topmast staysail till 4 P.M., when I handed upper topsails and reefed the courses; wind still at about from E. by S. to E.N.E., and increasing; barometer falling. 6 P.M.—Handed the courses; sea getting confused; weather had a bad appearance. At 8 P.M. barometer 29·20; still standing on S.E., and by midnight every indication of a hard blow. Handed lower fore-topsail; my estimated distance now 25 miles S.E. by S. of light-ship, and ship hove to upon port tack; wind and sea increasing; a bad appearance; barometer down 4 A.M., 31st, to 28·80, and at 7 A.M. the port main-topsail sheet carried away. I then goose-winged main-topsail; wind now a perfect hurricane; barometer 28·60; dense heavy rain, and sea running mountains high; and at 2 P.M. (31st) a most terrific burst of wind, taking away starboard main brace bumikin, also main lifts; of course main-topsail went to pieces; ship now under a small weather cloth in mizzen-rigging; helm hard-a-starboard; wind and sea and rain blinding; ship on beam-ends; still upon port tack, and coming up; barometer now down to 28·50. When I thought it could not blow harder, after some trouble got main-yard secured by lashing port-yard-arm to port main rigging at dead-eyes. All starboard main and topgallant bulwarks gone by the lee sea; no weather water being shipped. 4 P.M., 31st.—Still same weather, wind veering northerly; barometer still at 28·50. At about 6 to 8 p.m. moon began to give a little light, and looking a little hopeful; weather getting rapidly better; sea falling, and by midnight I reckoned the worst of it was *over*, and by daylight of the 1st November weather fast improving; sea going down quickly. I found ship had shifted nearly all the ballast to starboard. Now employed turning ballast and ship upright, and got ship main-topsail shifted by noon, and put ship's head to the north again and made all possible sail; wind veering to the west of north, and barometer rising slowly. Ship's position at noon, 1st November, latitude observation 18° 59′ N. and longitude by chronometer 88° 24′ E. Weather now very fine; two pilot brigs and several other vessels in company; sea smooth, and at noon of 2nd November I took a pilot, Mr. McCaskell, on board by sending my boat; latitude 19° 5′ N., longitude 88° 25′ E., and owing to the light winds, I was 12 days getting back to the light-ship, and proceeded up in tow of steam-tug *Victoria*. From 1st to the 6th November passed a great number of dead human bodies and cattle, latter in hundreds, also what appeared to be roofs of houses and house furniture, and miscellaneous wreckage.

Abstract Log of the Ship "British Statesman."

Left Liverpool July 21st. Had a good run down to 18 degrees north latitude, then light southerly winds down to the Equator. Strong south-east trades and good running breezes off the Cape. Passed close to the Nicobars and Andaman Islands, and had strong easterly winds and dirty weather up the Bay of Bengal. At 10 p.m. on Monday, October 30th, rounded to about forty miles east of outer light-ship, and finding a heavy swell coming in from S.S.E. and the barometer falling, stood off into deep water. Had strong winds steady N.E. At 8 a.m. on Tuesday, having stood off fifty miles S.E., we had a lull for a few minutes, followed by a furious whirlwind, which blew away all the sail we had set. It blew very hard all day, and at 4 p.m. it increased to a hurricane, still from N.E. At 6 p.m. the topgallant masts blew away; at 8 p.m. the ship was lying nearly on her beam ends from the sheer force of the wind. The sea stove the main and after hatches, tables, settees, and all fittings smashed up, and all the officers' clothes lost; gutted the cabin, forecastle, and houses, and washed the steward out of the cabin overboard; cut away the topmasts, and shortly afterwards the fore and mainmasts went by the board, taking the lee bulwarks with them. It was a fearful sight; the sea and the sky seemed one seething mass, and the roar was terrific. At 11 p.m. had most vivid lightning from all directions, and shortly afterwards it moderated. Kept no record of the gale, as our barometer and compasses were washed away during the early part of the evening. The last reading of the barometer was 28·20. At daylight moderate and fine.

Abstract Log of the Barque "Clarence."

Night-time, Monday, 30*th October* 1876, 8 a.m.—Received Mr. Collingwood, pilot, on board. Eastern Channel Light-ship N.E. 72 N., ½ mile. Made sail and stood to the S.E. 11 a.m.—Tacked to the northward. Noon—Strong winds from N.E. and squally, with continued rain and heavy swell from S.E.

Night-time, Tuesday, 31*st October* 1876, 0·45 p.m.—Eastern Channel Light-ship E. ½ N. Set plain sail. 2 p.m.—Tacked to the S.E. 4-30 p.m.—Tacked to the northward. 6 p.m.—Tacked to the S.E. 8-40 p.m.—Came to anchor in 8 fathoms on port bower, 45 fathoms to the water. Eastern Channel Light-ship S.E. ½ E., 1 mile. Furled sails and set anchor watch. Midnight.—Strong winds from N.E.; sky overcast with faint lightning in S.E., and heavy swell; ship rolling very heavy. 2-5 a.m.—Moderate gale with heavy sea; parted port chain about 30 fathoms shackle, hove the end up; set lower topsails, jib, and furled top staysail, and stood to the S.E. 4 A.M.—Increasing gale and constant rain, with high sea getting up; wind N.E. by N. 6 A.M.—Split jib, handed same. 8 A.M.—Strong squally gale and constant rain. 10 A.M.—Handed furled topsail, split same; fierce gale with very high sea. People putting every moveable article in lower hold to stiffen ship. Noon.—Furious gale at N.N.E., with tremendous sea; handed main topsail, split same. Eastern Channel Light-ship N.E. by N., 6 miles; several vessels in company; wind north; barometer 29·40, aneroid 29·35, thermometer 81.

Night-time, Wednesday, 1st November.—Tremendous gales, with high confused sea and terrific squalls at intervals; wind north; barometer 29·15, falling. 6 P.M.—Violent squalls and torrents of rain, with confused massive sea; wind N.N.W.; barometer 29·10. 8 P.M.—Squalls less violent and sea falling. Midnight.—Strong gale and squally; weather clearing up and sea much down; barometer 29·30. 4 A.M.—Moderate gale and squally. 5 A.M.—Strong breeze and moderately clear. 6 A.M.—Winds very moderate and clear; at N.W. two vessels in company disabled. 8-30 A.M.—Spoke ship *Penthisilea,* with mainmast gone and mizzen-topmast-head and lower mizzen-topsail yard hanging in two, and port bulwark flush with waterway from fore rigging to break of after house, and all sails more or less torn. 10 A.M.—Shifted main-topsails and set same. Noon.—Light westerly winds and fine clear weather.

Latitude observations 20° 2′ N., longitude chronometer 88° 20′ E., barometer 29·80, thermometer 81.

Abstract Log of Ship "Palmas," St. John, N. B., from 30th October to 2nd November.

SAILED from Negapatam October 12th, 1876, with 360 tons sand ballast for Calcutta. On the 30th October at noon, in latitude by account 20° 40′, longitude by chronometer 88·53; sounded, had 75 fathoms mud. Wind stiff at E.N.E. with an occasional heavy squall; ship heading up N. by W. and N.N.W. At 3 P.M. sounded, had 18 fathoms mud; weather inclined to get thick, with showers of rain and squall. 4-30 P.M.—Sounded, had 15 fathoms; tacked to S.E.; weather having a very threatening appearance and barometer falling, thought it advisable to stand out for a good offing, the sea rising very fast from S.S.W., with every indication of a stormy gale.

At 6-15 P.M., when about 18 miles E.S.E. of the Eastern Channel Light-ship, the look-out reported a boat on the port-bow. We immediately backed the main and cross-jack yards and stopped the ship; the boat pulled round the stern and got alongside under the lee quarter; took the men on board and pulled the boat on the deck; they proved to be the cook and three seamen of the ship *Prince Waldemar,* of St. John, N. B., Captain Smith, from Liverpool for Calcutta, cargo salt, 100 days out, which ship had run aground at noon that day on the Bulchery Reef. They reported that they were running the pilot station with a press of canvas, and that she struck a little before noon, and that in a few minutes after she struck her forefoot was seen floating alongside; they got the boats out, and these four men got into one, and they broke adrift; having only two oars in the boat, they failed to pull back to the ship, and were driven adrift. Some time after they got adrift they saw the masts falling down, and saw the captain and his wife and children and remainder of the crew on the poop. They then saw the ship *Lady Octavia* standing out; they pulled after her, but failed to fetch her, and they ran before the wind, and we picked them up at 6-15 P.M. 18 miles E.S.E. of the Eastern Channel Light-ship. At midnight, barometer falling from 29·80 to 29·50, took in the courses and jibs and kept upper topsails on, to get to the southward, as the sea was rising very rapidly from S.S.W. with thick rain, and weather looking very threatening. October 31st.—At 4 A.M. took in upper topsails and made all preparations for a strong gale, the sea rising to a fearful height; wind still at E.N.E., steady. October 31st, 8 A.M.—Heavy gale; barometer 28·90; took in lower mizzen-topsail, and while taking in it blew away. Noon.—Latitude by account 19° 50′ N., longitude by account 88·50 E.; barometer 28·70; increasing gale with thick rain; wind inclined to veer round to N.E. By this time I found it must be an approaching cyclone, barometer still falling rapidly, and that the ship was in the N.W. quarter of the storm; cyclone travelling from S.S.W. to N.N.E. At 2 P.M. the heavy sea and lurches (assisted by the quantity of water gone below) caused the sand ballast to shift to starboard, causing the ship to have a heavy list to leeward; with the heavy lurching the 90 fathoms of starboard chain broke adrift and was thrown on the lee gunwale, and at the same time all the sails and provisions, &c., on the weather side of the fore cabin were thrown to leeward, throwing the ship almost on her beam ends. We slacked away fore and main-topsail sheets to try and right her, the fore one blowing away in the act; had to slack off the main-topsail sheets till it blew away. We squared the main and cross-jack yard and put the helm up to try and put her on the other tack to get the low side up, although we were already on the right tack for the cyclone; but the ship would not pay off, but continued to come up as the wind was hauling more northerly, and causing the heavy S.S.W. sea to break in over our lee rails and poop and endangering the safety of the ship by knocking against the hatches. When in this position, cut away top-gallant back-stays, the masts going over with their gear and fouling the topsail yards; could not cut them clear, as all the wire got twisted and turned together. 4 P.M.—Cyclone increasing; barometer 28·50; the sand still shifting to leeward, and putting her on her beam ends. I saw then that the next thing to cutting the masts away would be to let go the starboard anchor and let it run the 90 fathoms chain from the leeside. I went forward with the chief officer and saw all clear and let it go, taking the 90 fathoms chain with it. The ship then righted a great deal, and less sea coming over the rails, we then had a chance to go below to trim some of the ballast, and sent all hands below for that purpose, leaving the carpenter, sailmaker, and one man on the deck to look out for the hatches and tarpaulins. In the meantime the top-gallant masts and yards were swinging about and cutting the topsails and courses adrift from the gaskets, and causing them to be blown away. At 6 P.M., barometer 28·20, had the heaviest blow, centre of the cyclone then passing about 40 miles to the eastward, the wind hauling to N.N.W. and N.W., with fearful vivid flashes of lightning, thunder, and rain, at which time the whole of the remains of our sails were blown away; the fore-topgallant yard had by this time got down end on alongside, and knocking against the side and chafing very much, but could not cut it clear. At 7 P.M., the gale abating, ceased trimming, the men being all tired and worn out, and the S.S.W. sea being then nearly aft; ship heading up N.E. by N. and rolling much less. 3 P.M.—Gale moderating; barometer having risen 28·50, let all hands go to rest, ready for the next day's work to clear the wreck and trim ballast. Midnight.—The weather clearing and wind moderating; barometer 29·10. November 1st, 4 A.M.—Strong breeze and clear weather. At 5 A.M. turned all hands to clear the wreck; cut down top-gallant masts and yards, and sent down the remains of sails to make clear for bending. Noon.—Latitude by observations 19° 22′ N., longitude by chronometer 89° 10′ E. The French barque *Tharo* bore down on us and asked if we required assistance; compared chronometers. All hands at work till 8 P.M., then let all hands go to rest; fine night and clear weather. November 2nd.—All hands bending sails; latitude at noon 19° 43′ N., longitude 88° 57′ E.; ship having drifted 24 miles N.N.W. in 24 hours. 5 P.M.—Finished bending sails; started to heave the anchor up, but could not get one paul of the windlass. We then rigged a treble purchase outside the bow on the chain and took it to the winch, and tried both winch and windlass together; we got three pauls, or one link. By 7 P.M. we knocked off heaving chain and trimmed ballast ready to make sail. At 9-30 P.M. slipped the chain at 90 fathoms and made sail and stood to N.W. November 3rd, 4 A.M.—Sighted a ship ahead disabled.

On the 6th November, while sailing towards the Mutlah Light-ship from the S.E., we passed dozens of drowned buffaloes, several human bodies, torn bamboo huts, and a great number of trees of all kinds with roots and branches, and whole masses of jungle stuff, which was a certain sign that the cyclone had done much damage on shore as well as out to sea, having travelled from S.S.W. to N.N.E. up to the top of the Bay of Bengal. At 4 P.M. passed the end of Bulchery Reef, but could not see anything of the wreck of the *Prince Waldemar*.

Report of Ship "Thessalus" as to weather, winds, &c., experienced from 8 A.M. *on Monday,* 30*th October, till midnight, Tuesday,* 31*st.*

DATE AND POSITION.	Hour.	Wind.	Force.	Barometer.	Attached thermometer.	Weather by Beaufort's scale.	REMARKS.
Monday, 30th	8 A.M.	E.	4	30·000	80·0	O.	The barometer I use is a Board of Trade instrument. I keep a journal for the Meteorological Society, and correction can be obtained, if necessary.
20° 28′ N., 90° 55′ E. steering for Mutlah.	10 „	......	......	30·026	......	......	
	Noon	E. by N.	5	29·962	81·1	O.	
	4 P.M.	N. E.	5	29·886	82·0	O.	
	8 „	N. E.	6	29·908	81·0	O.	
Tuesday, 31st	Midnight.	N. E.	7	29·826	80·2	C. B.	
Mutlah Light-vessel W.N.W. 6 or 8 miles.	4 A.M.	N. E.	7·8	29·740	80·2	O. B.	I crossed the Equator in 83° E. shortly after noon of 24th October. From that time I had strong winds and squally weather from westward, W.N.W. to W.S.W., and S.W. to 9° N. The wind then hauled southward S.S.E., then S.E., weather still keeping very squally and overcast, and wet to 18° 30′ N., the sun being obscured for four days. On Monday at 8 A.M. I was in 20° 30′ N. and about 90° 20′ E., having gone further east than I intended; the wind was then E.; force 4. I steered for Mutlah, and made it at midnight. On Monday the breeze had increased, but not a great deal, and continued steady at about N.E. At 4 A.M. on Tuesday there was no indication by barometer of more than a gale or stiff breeze; but at 8 A.M., when it was too late to do anything, the gale being on us, the barometer fell considerably. At 5 A.M. I had Eastern Channel Light-vessel by N. 5 miles. As I could see nothing of the brigs, I wore ship and ran S. and S. by E., and nearly buried the ship before I could get sail off her, there being a terrific sea from southward. After running S. about 20 or 25 miles, I hauled ship to the wind to ease her from plunging so, under three lower topsails and fore-topmast staysail. At about 10 A.M. the topsail began to go, main one first, then fore one; then I set a reefed upper main-top sail (a new sail); it also blew away after being set half an hour; then fore-topmast staysail went, then mizzen topsail. We were then under bare poles and rags, for the men could do nothing aloft. I put a weather cloth in the mizzen rigging, which helped to keep her head up to the wind. I should have squared the head yards, but was afraid to start the traces, the force of the wind was so great. At about 2-30 P.M. our main-top-gallant mast carried away just above the cap (it was a *strong spar* and well supported with good wire rigging), the wreck of yard and mast doing great damage to our lower rigging and bulwarks, as we could not get it cut clear of the other rigging. The sea at this time was wild beyond all description, the ship putting her lee side under water at times up to the dead-eyes of lower rigging, and the southerly swell setting us up against the wind every now and then made our masts bend like bamboos. Now and then a sheet of spray would hide the whole fore part of the ship from my view. The rain fell with such force that my eye became so sore that I could scarcely see, and I think a lot of sand was flying about. The cloud in the W.S.W. quarter scattered a little once or twice, and I was in great fear of the wind flying round from that quarter. I imagine I had the worst of it at about 4 P.M. Between 6 and 8 P.M. the wind took off, and at 8 P.M. there was a very decided improvement in the weather, as there was less wind, and the sea had fallen considerably. All our fore and mizzen top-gallant royal yards were swinging about, traces carried away, endangering the masts, but by midnight we had got them secured. The sea fell *very* fast indeed, and on Wednesday there was not the least indication by it of a great storm having passed over us the day previous. Wednesday morning, I saw ship *Penthesilia* with the main-mast gone.
4 A.M.—Eastern Channel Light-vessel N. W by W. 9 miles.	8 „	N. E. by N.	9·10	29·600	79·1	O. R.	
	Noon	N. E. by N.	11·12	29·400	......	O. R.	
	about 4 P.M.	N. by E.	12·11	29·050	......	O. R.	
			11				
	8 „	N. or N.N.W.	10	29·420	......	O.	
	Midnight.	N. W. or W. N. W.	6·5	29·700			
Wednesday, 1st November	4 P.M.	......	......	29·810			
Latitude noon 19° 52′ N., longitude 87° 54′ E.	8 „	......	......	29·930			

Log of the Indian Government Pilot-Vessel "Coleroon," MR. G. B. SMART, *Senior Branch Pilot, Commander, and* MR. R. L. LONG, *Branch Pilot, in temporary charge.*

30TH OCTOBER 1876, BUOY STATION.

Hour.	Barometer.	Aneroid.	Thermometer.	Wind.	Force.	Weather.	Position.	REMARKS.
A.M.								
2	30·15	30·06	82	W. ...	Light ...	Cloudy, with lightning, and threatening appearance to S.E.	Eastern Channel Light S. by E. ½ E., 6 miles.	2 A.M.—Light west wind and cloudy, with threatening appearance to the S.E., with lightning. 3-30 A.M.—Sighted a light to the S.E. Daylight.—*Foam*, pilot-vessel, at anchor S.E. ½S.; threatening appearance to S.E., with lightning. 6-20 A.M.—Heavy squall to the S.E., with rain. 7 A.M.—Hoisted to the *Foam*, pilot-vessel, R. and W., two masters and one mate, and observed a barque in want of a pilot to the southward in company with *Foam*, pilot-vessel, and *Sind*, steam-vessel, proceeding up channel. 7-40 A.M.—Sighted a vessel to S.E. 8-15 A.M.—Two vessels to the S.E. At 11 A.M., weather assuming a threatening appearance, in first reef of the topsails. Noon.—*Sestos*, steam-vessel, passed in. At 3-30 P.M. hove up and made sail, and stood down on the port tack under single-reefed topsail, courses, and main-topgallant sail. Hoisted RN to the inward-bound ship with signal flying for a pilot, and SDP (G. Code). At 4-30 P.M. put Mr. Broadhead, master, on board the ship *Canon Harrison*. 5 P.M.—Sighted a steamer to the S. W. 5-40 P.M.—Put Mr. Cooper, master, on board of the *Chancellor*, steam-vessel. Sunset.—A ship inward bound standing to the S., and *Chancellor*, steam-vessel, E. *Foam*, pilot-vessel, not in sight, and a barque inward bound with a pilot on board N.E. At 8 P.M. set the watch. At 11-30 P.M. blowing fresh from N. E., with heavy sea; took in the main-topgallant sail, and in second reefs of the topsails. Midnight.—Wore round to the northward the usual station lights shown.
4	30·08	30·0	82	N.E. ...	Moderate ...	Squally to S. E. ...		
6	30·10	30·0	80	N.E. ...	Ditto ...	Ditto.		
8	30·15	30·02	79	E.S.E. ...	Ditto ...	Ditto.		
10	30·15	30·01	79	N.E. ...	Ditto ...	Ditto.		
N.	30·05	30·02	80	N.E. ...	Fresh ...	Cloudy with a heavy sea.		
2	30·02	29·95	80	N.N.E. ...	Ditto ...	Ditto.		
4	30·0	29·94	80	N. E. ...	Ditto ..	Ditto ...	Eastern Channel Light S. E. ½ E., 6 miles.	
6	30·0	29·93	81	N.E. ...	Ditto ...	Ditto ...	Ditto E. by S., 7 miles.	
8	30·10	29·94	81	N.E. ...	Ditto ...	Ditto ...	Ditto N.E., 4 miles.	
10	30·0	29·92	80	N.E. ...	Ditto ...	Ditto ...	Not in sight.	
M.	30·0	29·91	80	N.E. ...	Ditto ...	Ditto ...	Ditto.	

Log of the Indian Government Pilot-Vessel "Coleroon," MR. G. B. SMART, *Senior Branch Pilot, Commander, and* MR. R. L. LONG, *Branch Pilot, in temporary charge*—(Continued).

31st October 1876, Buoy Station.

Hour.	Barometer.	Aneroid.	Thermometer.	Wind.	Force.	Weather.	Position.	Remarks.
A.M.								
2	30·00	29·90	83	N.E. ...	Strong ...	Thick rain and threatening appearance.	Eastern Channel Light not in sight.	Sounded, 18 fathoms; assuming a more threatening appearance; took in the mainsail, jib, and spanker, and wore round to the eastward. 4-30 A.M.—Sighted the Eastern Channel; blue-light bearing N.E. by N. 6-30 A.M.—Wind increasing to a moderate gale, with lightning to the S.E. and the weather assuming a more threatening appearance to the S.E.; hauled the foresail up, and set the fore and main-staysails. 8 A.M.—Gale still increasing, with hard squalls and rain; close reefed the topsails, reefed the courses, and stowed them. 9 A.M.—Gale blowing with great violence, with heavy squalls and rain; stowed the topsails, and got preventer lashings on all the sails, and battened down fore and aft, and secured the main skylight. 10 A.M.—Gale increased to a hurricane, with a very heavy sea. 10-20 A.M.—The tack of the main-staysail carried away, reefed it, and set it again. At 11 A.M. the span of the weather quarter boat carried away. At 11-20 A.M. the fore-topmast staysail blew completely away with the violence of the wind. At 2 P.M. the main-staysail tackle carried away, and the after leech rope of the main staystall carried away. At 5 P.M. the wind veered to the N.W. with great violence, and the quarter-deck awnings above and below began blowing away; secured them as much as possible, and saved the canvas. At 8 P.M. the barometer rising, the gale began to abate considerably also. Midnight.—Moderate gale from N. W.
4	29·85	29·80	80	N.E. ...	Ditto ...	Cloudy	Ditto.	
6	29·84	29·78	80	N.N.E....	Fresh gale ...	Heavy sea	Ditto.	
8	29·83	29·78	80	N.N.E....	Strong gale ...	Ditto	Ditto.	
10	29·60	29·65	80	N.N.E....	Ditto ...	Ditto	Ditto.	
N.	29·35	29·50	79	N.N.E....	Ditto ...	Ditto	At sea.	
2	29·23	29·30	79	N.N.E....	Ditto ...	Ditto	Ditto.	
4	29·20	29·25	79	N.N.E....	Ditto ...	Ditto	Ditto.	
6	29·30	29·25	79	N.W. ...	Ditto ...	Ditto	Ditto.	
8	29·35	29·40	79	N.W. ...	Moderate ...	Ditto	Ditto.	
10	29·57	29·43	80	N.W. ...	Ditto ...	Ditto	Ditto.	
M	29·70	29·60	80	N.W. ...	Ditto ...	Ditto	Ditto.	

1st November 1876, Buoy Station.

A.M.								
2	29·89	29·80	78	N.N.W....	Fresh gale ...	Cloudy	Unknown	Daylight.—Nothing in sight; discovered the bolt on the stem, for the inner bobstay had carried away; set hands to secure it. 7 A.M.—Set the topsails with one reef, and the courses, jib, and spanker, and secured the wreck about the deck. 8 A.M.—Sighted a vessel to the E. At 9 A.M. crossed the fore-top-gallant yard. Noon.—Latitude observed 21° 48' 46" N.[*] and longitude 88° 15' 45" E.; steered up north line, and streamed the patent log. Sunset.—Nothing in sight. 8 P.M.—Hauled in the patent log, which showed 6¾ miles. Set the watch. 8-15 P.M.—Sighted a steamer to the S.W. Between 8-30 and 8-45 showed three blue-lights, and the maroon constantly shown; but no notice was taken of either maroons or blue-lights, and the steamer proceeded up to the north. Midnight.—Nothing in sight.
4	29·92	29·83	78	N.N.W....	Strong breeze...	Ditto	Ditto.	
6	29·96	29·85	78	W.N.W....	Moderate ...	Fine	Ditto.	
8	30·05	29·95	78	W.N.W....	Ditto... ...	Fine and clear ...	Ditto.	
10	30·05	29·97	80	W.N.W....	Ditto... ...	Ditto ...	Ditto.	
N.	30·05	29·97	80	W. ...	Light airs ...	Ditto ...	Ditto.	
2	30·00	29·95	83	W.N.W....	Ditto... ...	Ditto ...	Ditto.	
4	30·00	29·94	83	W. ...	Ditto... ...	Ditto ...	Ditto.	
6	30·00	20·95	81	W. ...	Ditto... ...	Ditto ...	Ditto.	
8	30·07	29·98	82	W. ...	Ditto... ...	Ditto ...	Ditto.	
10	30·10	30·00	82	W.N.W....	Ditto... ...	Ditto ...	Ditto.	
M.	30·10	30·00	82	W.N.W....	Ditto... ...	Ditto ...	Ditto.	

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[*] This must be a mistake.—G B. S.

Ship "Scottish Chieftain," from Cardiff towards Calcutta.

Monday, the 30*th October* 1876.—Wind, N.E. 3 P.M.—Moderate breeze and hazy weather; all necessary sail set by the wind. 4 P.M.—Tacked ship to the eastern. 5 P.M.—Tacked ship to the northern. Wind, E.N.E. to S.E. 7-30 P.M.—In top-gallant sails, main-sail, crodjet, and flying jib. 8-30 P.M.—Sounded, got bottom in 80 fathoms, mud; ship under easy canvas. 11 P.M.—Sounded 80 fathoms, mud; lights and look-out carefully attended. A.M.—Increasing breeze and squally. 1-30 A.M.—Sounded 78 fathoms, mud; made sail and stood to the northern. 3-40 A.M.—Sounded 65 fathoms, mud. 7 A.M.—Sounded 50 fathoms, mud. 10 A.M.—Sounded 22 fathoms, mud; tacked ship to the southern and eastern. At noon pilot brig close to, with flag up, and steering to the southern and eastern, paying no attention to us. Asked him if he had pilots on board. Says,—"Yes, but too much sea to board." This day ends with moderate breeze and cloudy weather, with passing showers of rain. A short lump of a sea on from the southern.

Tuesday, the 31*st October* 1876.—Noon.—Increasing breeze from the north-eastern and cloudy weather; a heavy sea rolling up from the southern; barometer 29·80, and falling. Pilot brig, two ships unknown, and ship *Ghazeepore* in company, all standing off to the S.E. to get an offing. A cyclone evidently commencing up from the S.E. 4 P.M.—Strong breeze; shortened sail to three lower top-sails, fore-topmast-staysail, and main sponcer; wind N.E. to northern, and increasing to a fresh gale. 8 P.M. to midnight.—Gale increasing and squalls getting heavier, and a very heavy sea rising; barometer 29·62. Barometer fell from midnight to 3 A.M. 29·20; took every sail off the ship but fore-topmast-staysail and main sponcer, passing double gaskets on all the sails. Kept off to the S.W.; wind hauling to the northern. 4 A.M.—Heavy rain and blowing terrific in squalls. 8 A.M.—Constant rain, and blowing a perfect hurricane; hauled fore-topmast-staysail down; ship laying to, the main hatches in the water, washing away water-casks, harness-casks, and everything about the decks; filling cabins, half deck, and washing bunks' boards out of upper berths on the starboard side; large quantity of water going down larazth and booby hatch. 10 A.M.—Wind N., glass 29·10, and blowing a hurricane; ship on her beam ends. 11-30 A.M.—Cut away fore-topmast backstays and stays; fore-topmast went over the side, taking main-topmast, mizzen, topgallant-mast with it: ship righted a little.

Wednesday, the 1*st November* 1876.—Noon.—Blowing terrific, and lee rails continually under water; barometer 29·00, and oscillation about three-tenths; all hands employed trying to get clear of the wreck. The reason of cutting away the masts was for the safety of ship and cargo and all parties concerned. 4 P.M.—Glass rising, 29·10; still blowing terrific; wind N.N.W.; main sponcer blew away; ship laying with fore-topmast-staysail in mizzen rigging; ship on port tack. 8 P.M.—Wind hauling to the western; sent all hands off the deck until daylight, for fear of getting them hurt by falling pieces of wreck: ship labouring heavy and sea running over her fore and aft; ship laying dead in the trough of the sea; glass still rising, but almost impossible to set it. Pumps sounded every two hours; ship making more water. A.M.—Wind fallen and sea not so heavy; sky lifting occasionally. 4 A.M.—All hands trying to get clear of the wreck; at 10 A.M. succeeded in getting all clear forward and commenced on the main; ship still over on her beam ends. A large quantity of cargo shifted. This day ends with strong breeze and heavy sea running; sky getting more clear. As an inducement for the crew to extra exertions, Captain promised them one month's extra pay, providing we succeeded in getting the ship into pilot water without assistance.

Thursday, the 2*nd November* 1876.—Noon.—Moderating and sea fallen; all hands clearing away at the main. 4 P.M.—Succeeded in getting clear with all sail-yards and masts, blocks, and everything attached to them; ship's bulwarks and hull badly strained, and decks, rails, and skids badly cut up with fallen wreck. One forward boat stove. Used up one Manilla 4-inch four-stranded hauling line, one Manilla 4-inch three-stranded, and one 3½-inch hauling line, with fish and two catfaces with purchase blocks, sending down wrecks, lashings, &c., and likewise all the studding sail gear. 1 A.M.—Moderate breeze and clear weather; sea fallen and glass rising; weather getting settled. Employed sending down lower topsail yards and getting head-sail on the ship; set foresail, mainsail, and spanker, which is all badly cut up. The lower rigging and stays badly cut up.

Abstract Log of S. S. "Moulmein," which left Chittagong for Calcutta on 30th October 1876.

The 30th October 1876.—3-30 P.M.—Weighed anchor and proceeded to sea. Draft nine feet seven inches forward, and nine feet ten inches aft. 4-30 P.M.—Stopped and discharged pilot; light northerly wind and southerly swell. Midnight.—Overcast, with moderate N.N.E. wind.

	Barometer	... 29·75
Midnight.	Ditto	... 29·75

The 31st October 1876.—Commences with heavy southerly swell and overcast sky. 3 A.M.—Strong breeze and ship labouring heavily; wind N.E. by E. 6 A.M.—Overcast sky, with rain. 7 A.M.—In all awnings. 10 A.M.—Hove to, heading E.; wind hauled to N.E., and freshened, so ran before it to S W. Sent all passengers into saloon, and battened down forehatch: wind and sea increasing. Noon.—Wind N.E., with heavy confused sea; ship labouring heavily. 2 P.M.—Hove to on port tack as the wind hauled to E. and E.S.E., but in half an hour it hauled back to N.E., and then ran S.W. 4 P.M.—Ship broached to, and would not pay off again, so kept S.E., close to the wind, it blowing now a violent hurricane. 5 P.M.—Fore-topmast carried away; mail-boat on weather davit blown on board. 7 P.M.—Foremast carried away close to deck; crew refusing to work, being frightened; ship labouring heavily, and spray blowing right over the ship. Standard and steering compasses blown away. 10 P.M.—Wind N.N.E.; funnel carried away and rolled overboard; main-topmast carried away; put sail on weather rigging to heave ship to the lee; fires put out and the boiler ran dry; engines not able to work, and three feet of water in stoke-hole, with all pumps choked. From 11 P.M. wind decreasing.

3 A.M.	Barometer	... ... 29·70
4 "	Ditto	... ... 29·66
5 "	Ditto	... ... 29·64
6 "	Ditto	... ... 29·64
8 "	Ditto	... ... 29·64
11 "	Ditto	... 29·60
Noon.	Ditto	... ... 29·53
2 P.M.	Ditto	... ... 29·38
4 "	Ditto	... ... 29·15
6 "	Ditto	... ... 28·60
8 "	Ditto	... ... 28·40
10 "	Ditto	... ... 28·50

1st November 1876.—Commences with moderating weather and light rain; ship labouring heavily. Heavy swell from northward with light breeze; light N.N.W. breeze for remainder of the day; crew employed pumping and clearing away wreck. 10-30.—Sighted a steamer bound S.W., and signalled and got no answer. Midnight.—Southerly swell and ship rolling heavily.

4 A.M.	Barometer	... ... 29·50
8 "	Ditto	... ... 29·66
Noon.	Ditto	... ... 29·70
4 P.M.	Ditto	... .. 29·70
8 "	Ditto	... ... 29·71
Midnight.	Ditto	... ... 29·72

2nd November 1876.—Commences with moderate weather and southerly swell. Crew employed clearing away wreck and pumping ship. Three horses died and were thrown overboard. Noon.—Light breeze and fine clear weather. Signalled a barque and hoisted N. C.; could not make out her flags. 3-30 P.M.—Got jury funnel up and lit fires. 6-30 P.M.—Proceeded as well as able. Passed about three miles off the barque we signalled during the day. Midnight.—Light breeze and fine weather throughout.

4 A.M.	Barometer	... ... 29·72
8 "	Ditto	... ... 29·78
Noon.	Ditto	... ... 29·73
4 P.M.	Ditto	... ... 29·77
8 "	Ditto	... ... 29·76
Midnight.	Ditto	... ... 29·80

3rd November 1876.—Commences with light airs and calms with fine weather. 6 A.M.—Sighted a steamer and headed towards her. 7-10 A.M.—Stopped and boarded her—the *Victoria Schlizzini.* 7-40 A.M.—Proceeded again full speed in search of pilot brig; course E ½ N. 10-30 A.M.—Sighted pilot brig ahead. Noon.—Stopped and took Mr. Wawn, pilot, on board, and proceeded full speed towards Saugor. 8 P.M.—Stopped and anchored for the night.

4 A.M.	Barometer	... ... 29·87
8 "	Ditto	... ... 29·90
Noon.	Ditto	... ... 29·91
4 P.M.	Ditto	... ... 29·93

4th November 1876.—A light breeze and fine weather. 4-40 A.M.—Hove up and proceeded. 7-30 A.M.—Passed Saugor. 11 A.M.—Stopped at Diamond Harbour and landed mails. 3·45 P.M.—Arrived at Garden Reach. 4-30 P.M.—Arrived in Company's moorings.

Barometer ... ... 29·90
Ditto ... ... 29·93

Log of the Pilot Vessel "Foam," G. B. YOUNGS, *Branch Pilot, Commander.*

Date.	Hour.	Barometer.	Thermometer.	Wind.	Weather.	REMARKS.
Monday, 30th October 1876.	1	29·96	83	Calm	Cloudy and squally	2 A.M.—A heavy swell from S.E. and wind S. to E. 4 A.M.—Cloudy and lightning to S.E. Daylight.—Cloudy and overcast. 7-30 A.M.—Hove up and put Mr. Master Pilot Collingwood on board the barque *Clarence*, Eastern Channel Light-vessel bearing S. by E., two miles. *Coleroon* at anchor, bearing N.W. *Coleroon* made RN, two masters, one mate. After supplying the *Clarence*, the wind being N.E., stood down S. with first reef in the topsails, it being suspicious-looking weather; aneroid 29·80. Steam-tug *Sestos* cruising about. 9-20 A.M.—Took in second reef of the topsails. Wind steady from N.E., still going down S. 9-40 A.M.—Sent down topgallant yards; sea becoming heavier. Four inward bound vessels in sight bearing S. to S.W. of us. Made signal to them LS. Noon.—Wind N.E; sea confused. 0-45 P.M.—Ship *Scottish Chieftain* made MBK, answered it with C; ship made MBL, answered HTW; ship signalled HMC, answered FBNS; ship made signal not understood, showed HNF; ship made FGH, answered LSW, then CH; ship signalled VNM. 1·45 P.M.—Battened down hatches and screwed in dumb ports in between-decks and cabins. 2 P.M.—Sounded no ground at 30 fathoms; hauled to the S.E. 4 P.M.—Wind N.E., blowing fresh; heavy sea, and gloomy appearance; took in the third reef of the topsails; five vessels in company. 6 P.M.—Run to the southward; looking suspicious W.N.E.; squally with heavy sea. 8 P.M.—Hauled up to the S.E.; gale increasing; took in topsails and furled them; wind still N.E.; under fore-topsail and main-staysail and reefed main-staysail; gale increasing all night.
	2	29·94	83	Light airs ...	....	
	3	29·94	84	From N. E. ...	Very heavy sea	
	4	29·94	84	......	....	
	6	29·92	84	N. N. E.	Strong breeze	
	8	30·0	85	N. E.	....	
	10	29·96	85	N. E.	....	
	12	29·98	86	N. E.	....	
	1	......	......	......	Increasing to a gale	
	2	29·94	84	......	....	
	4	29·79	82	......	Fresh gale	
	6	29·78	82	......	....	
	8	29·79	82	......	Strong gale	
	10	29·80	82			
	11	......	......	......	Increasing.	
	12	29·82	82	......	Heavy squalls.	
Tuesday, 31st October 1876.	2	29·67	......	N. E.	Increasing to hurricane force and confused sea.	2 A.M.—N.E. gale with heavy confused sea; barometer 29·67, falling. 4 A.M.—Wind still increasing to a hurricane force; vessel behaving well. 6 A.M.—Heavy gale with confused sea; knocked away the centre port on the starboard side to allow the water to run off the decks, and opened all the other deck ports. At about 8 A.M. the two quarter boats broke adrift, and the davits carrying away the rail, secured them; wind increasing to a hurricane. Took in main-staysail; wind N.E. 10 A.M.—Blowing a hurricane; under foretop main-staysail; wind veering to N., but slowly. 11-30 A.M.—Barometer 29·24. Noon.—Blowing furiously under-bare poles; wind still veering to the N.; wind north; barometer 29·20 took in fore-topsail and main-staysail. 2 P.M.—Blowing a hurricane from N.N.W.; barometer 29·10; secured the anchors with double lashings; laying to under bare poles. 3-37 P.M.—barometer 29·2; blowing a hurricane from N.W.; confused heavy sea; taking a great deal of water on the decks. 4 P.M.—Barometer 29·5, rising; blowing still a hurricane from N.W., with heavy confused sea; lying to under bare poles. 5 P.M.—Barometer 29·27; blowing still with hurricane force from N.W.; vessel hove to under bare poles. 6 P.M.—Hurricane moderating; barometer 29·33. 7 P.M.—Barometer 29·45; a very red appearance all around; strong gale from W.; heavy coufused sea. 8 P.M.—Barometer 29·50; strong gale from W.; heavy confused sea; sky clearing. 10 P.M.—Still under bare poles; barometer 29·69; wind W., moderating; heavy sea. Midnight.—Moderating, heavy sea; set reefed main-staysail and fore-staysail; barometer 29·70.
	6	......	......	Boat got adrift	Confused sea.	
	9	......	......	N. E.	Heavy confused sea.	
	11·30	29·24	......	Wind veering to N.		
	12	29·20	......	North	Blowing furiously	
	2 P.M.	29·10	......	N.N.W. ...	Ditto	
	3·37	29·2	......	N.W.	Ditto, with heavy confuseu sea.	
	4	29·5	......	N.W.	Ditto	
		29·27	......	W.N.W. ...	Moderating	
	6	29·33	......	Ditto ...	Hurricane moderating... ...	

Log of the Pilot Vessel "Foam," G. B. Youngs, *Branch Pilot, Commander*—(Continued).

Date.	Hour.	Barometer.	Thermometer.	Wind.	Weather.	Remarks, Cruising Station.
Tuesday, 31st October 1876—*(Continued).*	7	29·45	……	West …	Heavy gale … … …	
	8	29·50	……	Ditto … …	Sky clearing … … …	
	10	29·63	……	Ditto … …	Moderating … … …	
	12	29·70	……	Ditto … …	Ditto.	
Wednesday, 1st November 1876.	2	29·72	81	……	…………	2 A.M.—Weather clearing up, heavy sea; barometer 29·72; still under main-stay and foretop main-staysail; wind W.; sea going down; barometer 29·73. 6 A.M.—W.N.W., moderate weather; barometer 29·80; made sail, opened the hatches; barometer 29·90. 7-20 A.M.—Sighted a steamer to southward. 10-30 A.M.—Made JBT to the S S. *City of Venice.* 11-20 A.M.—Put Mr. B. P. Philips on board the S. S. *City of Venice,* she sending her lifeboat for him. Sent up topgallant yards and made sail. 1 P.M.—Put the patent log over. 4 P.M.—Two inward bound vessels to S.E.; light winds from N.W.N. 6 P.M.—Patent log showed 6¼ miles. 8 P.M.—Two vessels to the S. and one to the N. Midnight.—Fine and clear; wind N.W. by N.
	4	29·73	81	West … …	Moderate … … …	
	6	29·80	85	Ditto … …	Ditto … … …	
	8	29·86	86	W.N.W. …	Ditto .. … …	
	10	29·90	82	……	…………	
	12	29·89	83	N.W. by N. …	…………	
	2	29·86	84	W.N.W. …	Light … … … …	
	4	29·84	84	……	…………	
	6	29·85	83	……	Fine … … … …	
	8	29·87	83	N.W. by N. …	…………	
	10	29·90	83	……	…………	
	12	29·99	83	……	…………	

T. C. Hoskin,
Chief Officer.

Abstract Log of the British India Steam Navigation Company's Steam-ship "Busheer," 153*rd voyage,* W. Loutit, *Commander, from Moulmein towards Calcutta viâ Rangoon.*

Date.	Winds.	Distances run.	Latitude.	Longitude.	Barometer.	Remarks.
			N.	E.		
30th October 1876	E.S.E. …	From Alguada Reef light, 89 miles.	16° 48′	93° 8′D.R.	29·75 29·73 29·68	1 P.M.—Fresh gale and passing showers. 5 P.M.—Fresh gale from east-south-east, with heavy running sea; ship labouring heavily and shipping seas fore and aft. 8 P.M.—Weather much the same, with increasing wind and sea; fire gear and boats ready. 10-30 P.M.—Strong increasing gale; in foresail. 11-20 P.M—In reefed fore-topsail. Midnight.—Wind still increasing; brought ship to the wind, and altered engines to half speed; very heavy sea running and ship labouring heavily; shipping seas fore and aft.
31st " "	S.E. …	……	Heading	Reaching …	29·65 29·64 29·62 20·60 29·52 29·55 29·60 29·65	1 A.M.—Ship hove to on starboard tack; rapidly increasing gale; two heavy squalls and rising sea; ship labouring heavily. 5-30 A.M.—Day-dawn broke behind a heavy bank of clouds with a lurid light to east-south-east, accompanied with vivid flashes of lightning. Terrific squalls from south-east with blinding rain; ship behaving well, but shipping large quantities of water; steaming half speed and keeping sea one point on starboard bow. 7 A.M.—Squalls increasing in violence, with heavy running sea; ship labouring heavily; threw deck-load of timber overboard to save the vessel; shipping large quantities of water, burying herself at times and recovering herself with difficulty. 8 A.M.—Ship relieved of deck-load, behaving herself better. 10 A.M.—Squalls of cyclonic force bursting over ship and burying her at times. Noon.—Cyclone in full force, with wind at east-south-east and inclined to veer to the southward. 0-30 P.M.—Weather clearing off overhead for a few minutes. 1 P.M.—Cyclone returning with increased fury; incessant terrific gusts from south-east with blinding rain; ship burying herself at times with rail under. 4 P.M.—Split fore deck weather boards and managed to batten up temporarily. 8 P.M.—Chief Engineer reported water in stoke-hole to be almost up to the fires and unable to fire with coals; opened fore hatch and supplied fires with timber shipped as cargo; rendering assistance in getting water out of stoke-hole. 8-30.—Wind veering to southward; cyclone abating; squalls less frequent. 10.—Wind still veering to southward; squalls light and less frequent.
1st November "	S.W. to W.	150	18° 52′	91° 46′	29·75 29·80	1 A.M.—Wind moderating fast, as also sea. 3 A.M.—Wind freshening a little and sea still running high. 6 A.M.—Wind and sea moderating; kept her head to west and put engines to full speed.

Log of the Ship "Nora," from Mauritius towards Calcutta.

TUESDAY, 31st OCTOBER 1876.

Barometer.	Hours.	Knots.	Fathoms.	Course.	Wind.	[illegible] of Compass.	[illegible]	Remarks.
	1	3	—	North.	E.S.E.	[illegible] E.	[illegible]	
	2	4	—	N.N.W.	——	[illegible]	—	
	3	4	—	N.N.E.	——	[illegible]	—	
	4	3	—	——	——	——	—	
	5	4	—	——	——	——	—	
	6	4	—	——	——	——	—	
	7	[illegible]	—	——	——	——	—	
	8	[illegible]	—	——	——	——	—	
	9	[illegible]	—	——	——	——		
	10	[illegible]	—	——	——	——		
	11	[illegible]	—	——	——	——	—	
	12	[illegible]	—	——	——	——	—	
	1	4	—	——	——	——	—	
	2	4	—	——	——	——		
	3	4	—	——	——	——	—	
	4	4	—	——	——	——		
	5	[illegible]	—	——	——	——		
	6	[illegible]	—	——	——	——		
	7	[illegible]	—	——	——	——	—	
	8	[illegible]	—	——	——	——		
	9	[illegible]	—	——	——			
	10	[illegible]	—	——	——			
	11	[illegible]	—	——	——			
	12	[illegible]	—	——	——	——	—	

P.M.—[illegible] with a strong [illegible] and high mountainous sea from the [illegible]. At [illegible] P.M. [illegible] wind to starboard, [illegible].
8 P.M.—[illegible], increasing with heavy squalls accompanied with [illegible] rain.
Midnight.—[illegible] ditto wind and weather.
[illegible] A.M. [illegible] of the lower fore-topsail [illegible] lower mizzen-topsail. Noon.—Wind blowing a hurricane with a very high sea.
Lat. Long. Course. Dist. Bar. Ther.
By observation [illegible]
By account [illegible] N. [illegible] N. [illegible] E. [illegible] miles.

WEDNESDAY, 1st NOVEMBER 1876.

Barometer.	Hours.	Knots.	Fathoms.	Course.	Wind.	[illegible] of Compass.	[illegible]	Remarks.
Noon ... 29·700	1	1	...	S.S.W.	E.S.E.	......	7	
29·500	2	1	...	......	......	......	...	
	3	1	...	......	......	......	...	
29·400	4	1	...	......	......	......	...	
	5	1	...	......	......	......	...	
29·300	6	1	...	......	......	......	...	
	7	1	...	S.W. by S.	S.E. by E.	......	...	
29·200	8	1	...	......	......	......	...	
	9	1	...	S.W.	S.E.	......	...	
29·100	10	1	...	......	......	......	...	
to	11	1	...	West.	South	......	...	
Lowest readings 29·050	12	1	...	......	......	......	...	
29·200	1	1	...	N.W.	S.W.	......	...	
29·350	2	1	...	......	......	......	...	
	3	1	...	N.N.W.	W.S.W.	......	...	
29·700	4	1	...	......	......	......	...	
	5	1	...	North	West	......	...	
29·800	6	1	...	N.N.E.	W.N.W.	......	...	
	7	1	...	S.W. by S.	......	......	...	
	8	2	...	......	......	......	...	
	9	2	...	......	......	......	...	
	10	3	...	......	......	......		
	11	3	...	......	......	......	...	
	12	3	...	......	......	......	...	

12·15 P.M.—Wore ship's head to S.S.W. to bow, the high sea setting up from south to S.S.W.; under lower main-topsail and fore-royal main-topmast staysail; hauled the staysails down when before the wind. At 4 P.M. wind blowing a hurricane, which by 10 P.M. had increased to a terrific one, with tremendous gusts and squalls; the up and lower topsail yards being lashed together, the weather braces of both carried away, the yards going to the lee back-stays. At 10·30 P.M. the lower mizzen-topsail (a new sail) split and blew to ribbons, the foot rope only remaining attached to the sheets. This was followed in about half an hour's time by the upper and lower fore-topsail, foresail, cross-jack, mizzen-topgallant sail, and main and mizzen-topgallant staysails, all successively blowing out of the gaskets, and more or less blowing away; all the sails had been made fast with extra gaskets and lines in addition to those in ordinary use.
11 P.M.—Wind blowing a terrific hurricane with tremendous gusts, accompanied with torrents of rain, and the spray blown from the tops of the waves, which were at this time very high; ship taking large quantities of water over the lee rail, and also at this time shipped a weather sea, which washed the battens and tarpaulins off the main and after hatches, allowing a quantity of water to go down between decks, and unshipped one of the boat's davits (port side) out of the lower socket, which slid down until the rail fetched it up. 1 A.M.—Shipped a weather sea, which staved in and knocked out of the chocks the port life-boat, and carried away the lashing eyebolt of the middle boat on the after skids; secured them in the best way possible under the circumstances; this sea also partly filled the starboard boat in the davits, which was turned in board, breaking several of the thwarts and starting the stern-post. At this time the hencoop on the port side of the poop was blown out of the lashings and smashed to pieces against the mizzen-mast.
Cordage.—Braces, topsail, halliards, running and standing gear, all severely chafed; the main braces (new rope) was cut through on the weather back-stays.
2 A.M.—Wind moderating, with strong squalls, but less frequent.
4 A.M.—Ditto ditto ditto moderating; still a very high sea; ship rolling excessively. 5 A.M.—Fresh breeze with less sea and fine weather; sounded, found sand and mud in 50 fathoms.
7 A.M.—Moderate fresh breeze; confused sea; wore ship and set upper and lower mizzen-topsail, upper mizzen-topsails, outer and inner jibs, fore-topmast, main-topmast, and mizzen-staysail and spanker. 10 A.M.—Crew employed sending down the remains of the sails that were split, and proceeded getting others in their place.
Noon.—Light breeze and beautiful fine weather; sea very smooth. Six inches in the well; pumped ship.

	Lat.	Long.	Course.	Dist.	Bar.	Ther.
By observation	20° 33′ N.	91° 7′ E.	N. 30° E.	77 miles.	29·880	79°

D. NAPIER, *Master.*

Extract Log of the F. L. V. "Planet" during the Cyclone, October 31*st*, 1876.

Date.	Hour.	Barometer.	Aneroid.	Wind.	Remarks.
	A.M.				
31st October	4	29·78	29·78	E.N.E.	A.M.—Still blowing hard with heavy sea on; vessel rolling and pitching greatly at times; pumped ship. 8 A.M.—Blowing a gale, with dirty hazy appearance all round, and heavy sea on. Battened down fore and aft, and made all snug for a cyclone. 9-30 A.M.—While taking in quarter deck awning it blew clean out of the bolt ropes. 11 A.M.—Hauled up starboard coir cables and bent it to the waste anchor. Noon.—Blowing a cyclone. 3 P.M.—Lost our starboard quarter boat; vessel rolling so heavily she filled, and with the heavy sea carried away all the gear. 5 P.M.—Parted port cable chain at 125 fathoms; vessel taking in heavy seas fore and aft. 8 P.M.—Still blowing a heavy cyclone, and shipping great quantities of water; lost one of the side ports and one of the waste boards. 10 P.M.—Still blowing a heavy cyclone, with no appearance of the weather clearing. Barometer and aneroid still falling. 1 A.M.—Cyclone at its height; vessel shipping very heavy seas, filling the decks fore and aft. One of the eyebolts securing the gun gave way, and the gun went overboard, also both the cook's funnels. 2-30 A.M.—Observed a break in the sky; barometer and aneroid steady. 3 A.M.—Weather moderating, glasses rising, and sea going down. At 4 A.M. got soundings, 13 fathoms, and let go port waste anchor and brought vessel up with 80 fathoms of coir cable. Crew being fagged out, sent them to rest.
Ditto	8	29·78	29·78	......	
Ditto	12	29·78	29·78	E. by N.	
	P.M.				
Ditto	4	29·78	29·78	E.N.E.	
Ditto	6	29·78	29·78	E.N.E.	
Ditto	8	29·78	29·78	E.N.E.	
Ditto	9	29·40	29·40	E.N.E.	
Ditto	10	29·20	29·20	E.N.E.	
Ditto	12	29·00	29·00	E.N.E.	
1st November	1	28·90	28·90	N.E.	
Ditto	2	28·80	28·80	N.E.	
Ditto	3	28·80	28·80	N.E.	
Ditto	4	29·20	29·19	......	
Ditto	5	29·50	29·50	N.	
Ditto	6	29·60	29·59	N.W.	

Vessel heading during the time she was adrift E.N.E. and N.E.

C. H. Smith,
Acting Commander.

CHAPTER II.

Meteorology of Northern India and the Bay of Bengal from 10th October to 31st October.

The easterly winds which prevailed in Upper India after the breaking up of the Vizagapatam cyclone continued until the 18th or 19th, gradually decreasing in force. They were accompanied by rainfall over the whole of Upper India, from Bengal westwards to the Punjab. The rainfall over the Bay of Bengal, judging from the returns of Port Blair, Nancowry, and the coast stations, was during this period very slight.

The barometer, which before and during the breaking up of the Vizagapatam cyclone had been abnormally low, rose rapidly on the 11th, 12th, and 13th, and during the next ten days was from ·1″ to ·13″ above the average. The causes of these variations of pressure of long period are as yet very imperfectly known. They are intimately connected with oscillations of temperature, the changes of one, when the variations in the amount of aqueous vapour in the air are small, being inverse to the other—that is, a continuous fall of the mean daily temperature is associated with a continuous rise of the barometer, and *vice versa*. The temperature of Upper India after the Vizagapatam cyclone was very considerably below the average, falling rapidly from the 10th.

The following tables illustrate the two facts of diminished air temperature and increased atmospheric pressure over Northern India at this time:—

STATIONS.	Mean pressure, 10th to 20th October.		Mean pressure, 10th to 20th October 1876.	Variation from mean.
	Years.	Average.		
Roorkee	17	28·924	29·037	+ ·113
Agra	17	29·254	·355	+ ·101
Lucknow	17	·437	·552	+ ·115
Benares	17	·578	·651	+ ·073
Patna	8	·688	·746	+ ·058
Calcutta	8	·834	·919	+ ·085
Sibsagur	3	·569	·654	+ ·085
Akyab	8	·828	·954	+ ·125
Port Blair	9	·746	·895	+ ·149
Madras	7	·827	·925	+ ·098

STATIONS.	Mean temperature, 10th to 20th October.		Mean temperature, 10th to 20th October 1876.	Variation from mean.
	Years.	Average.		
Roorkee	17	76·2	71·6	— 4·6°
Agra	17	82·1	75·3	— 6·8°
Lucknow	17	79·7	74·3	— 5·4°
Benares	17	80·8	76·5	— 4·3°
Patna	8	80·1	75·9	— 4·2°
Calcutta	8	82·2	80·3	— 1·9°
Sibsagar	3	76·8	72·6	— 4·2°
Akyab	8	81·5	80·2	— 1·3°
Port Blair	9	79·8	80·7	+ ·9°
Madras	7	78·6	83·1	+ 4·5°

The humidity, more especially in the North-West Provinces, was above the average. The last rainfall in these provinces and in Behar was on the 18th and 19th, after which the dry cool weather which follows the rains set in. The wind direction and velocity during this period show the prolonged intrusion of the monsoon current in Upper India. The easterly and south-easterly winds which were prevalent over the Gangetic valley from the 10th gradually diminished in intensity until the 19th, when they were succeeded by the cold-weather opposite current. But during the period of transition from the 19th to the 21st of the month there was a condition of calm and almost perfect atmospheric equilibrium over the whole of the Bay of Bengal and Northern India. The wind velocity at a number of stations for these two days is given in the following table:—

STATIONS.	WIND VELOCITY.		AVERAGE DAILY WIND VELOCITY.			
	19th October 1876.	20th October 1876.	Months of July, August, and September.		Months of October, November, December, and January.	
			Years.		Years.	
Roorkee	31·1	26·2	4—5	65·5	5	35·5
Lucknow	53·0	41·0	3	76·6	4	39·2
Patna	44·2	39·2	4—5	93·7	5	55·9
Calcutta	44·4	68·3	8	103·4	6—8	91·4
Sagar Island	105·0	114·5	5	253·4	4—5	124·9
Madras	109·0	179·0	5	225·1	5	191·5
Nancowry	7·3	42·7	3	290·5	2—3	190·2
Akyab	41·0	39·0	4	72·1	3—4	57·3
Dacca	36·3	48·0	7	152·7	7	49·5
Sibsagar	31·0	41·4	2	73·9	2	40·9

The meteorological features of Northern India and the Bay were consequently at this time very simple and clearly marked. Increased atmospheric pressure (from ·1″ to ·15″ above the average) and diminished temperature over the greater part of the land area accompanied the almost quiescent state of the atmosphere which characterised the period of transition from the south-west to the north-east monsoon. What is, however, more important in the discussion of the causes of the cyclone is the near approach to equality of pressure over the whole of this area at this time. Thus on the 20th the barometric difference between Nancowry and Madras was only ·011″, between Nancowry and Sagar Island ·021″, and between Nancowry and Roorkee (a distance of 1,700 miles) only ·047″. These differences are so small that, if the moving mass between the two last stations were water instead of air, it would be equivalent to a difference of pressure spread over the interval of 1,700 miles of $\frac{1}{40}$ of a ℔. on the square inch, or a head of ·6 inches. Even taking into account the small density of air, the reversion of the current at this change of the monsoons over India and the Bay of Bengal cannot be primarily assigned to the small differences of pressure which actually existed within the geographical limits of India.

So far then as our meteorological knowledge goes, there was at this period as near an approach to an almost perfect equilibrium of meteorological conditions and actions over a large area as probably ever obtains. At such a time, as I have already indicated in the discussion on the Vizagapatam cyclone, if the conditions are such as to favour the gradual retreat of the south-west monsoon southwards, and the establishment of the north-east trade wind over India, the formation of a cyclone and its advance northwards or north-westwards is impossible. If, however, the pressure is high to the south of the Bay of Bengal, from the existence of any of the various causes which might produce excessive pressure near the Equator, the south-west monsoon will continue to prevail in the lower portion of the Bay, and the formation of a cyclone becomes not merely possible, but certain, if the conditions last long enough.

In the former case of the establishment of the north-east trade wind over the whole of the Bay, the vast quantities of aqueous vapour produced by evaporation are carried away to the south-west, to give rain to the Madras coast, southern India, and other regions further south. In the latter the aqueous vapour due to evaporation in the Bay has no horizontal outlet, the north-east and south-west winds on opposite coasts indicating that at this time the atmosphere is in the condition of a land-locked area: hence the only possible motion of the vapour is that of vertical ascent or expansion. There thus commences almost immediately a vertical current, or an expansion followed by condensation and rainfall, over the area of production. The holding off of the rains during this month along the Coromandel coast favours this assumption in the present instance. The rainfall at Madras for the month was 1·04″, of which only ·4″ fell during the last fortnight. The average rainfall for the month during the period 1822—1843 was 10·09″.

The high pressure to the south of the Bay which accompanied the continuance of the south-west monsoon in the south of the Bay is indicated by the logs of three vessels. The captain of the *Tennyson* states that from the Equator to latitude 10°N. he had light baffling winds, with a high barometer. Captain Piton, commander of the ship *Lightning*, in his remarks, says that he crossed the Equator on the 12th, and advanced very slowly northwards, reaching latitude 9°17′N. on the 23rd; and that during this interval he experienced very light winds and calms with showers of rain and hot sultry weather, the sun being so hot as to boil the pitch out of the seams of the deck. The *City of Venice* passed round Ceylon on the 26th. Her log from the 21st shows that in the Arabian Sea, in the same latitudes as Port Blair and Nancowry, the pressure was unusually high, and that the weather up to the 25th was fine and clear, with light breezes. On the 25th, to the west of Ceylon, she had variable and light winds with unsettled weather, showing the transition from the region of high pressure, and fine weather on the south and west to the area of disturbance in the Bay of Bengal.

These extracts from the logs of the three vessels seem to be sufficient evidence to establish generally the fact of an excess of pressure, due to some unknown action, at and near the Equator. It is further confirmed by the returns from the Ceylon stations, which show that the pressure over the island was on the 19th and following days from ·06″ to ·09″ above the average. This excess of pressure, usually not large in amount, north and south of the area of cyclone generation prior to the formation of a cyclone was pointed out by Mr. Willson as a marked feature of the Midnapore cyclone, and by Mr. Blanford as accompanying the barometric depression in the Bay which preceded the Calcutta cyclone of 1867.

I shall now proceed to discuss the meteorology of the Bay and Upper India day by day, with the aid of the small charts (Plate II). These give the isobars either for the day, as in the case of the charts from the 20th to 29th, or for the actual hour of observation indicated on the charts, as in the case of the 30th, 31st, and 1st, together with synchronous wind observations at the various observing stations at 10 A.M. in the case of the charts up to the 29th, and after that day of the hour named on the chart. The wind directions in various parts of the Bay are derived from the logs of the vessels traversing the Bay and given *in extenso* in the preceding chapter.

October 20th.—The isobars in the chart for this day indicate, what has been already pointed out, the near approach to equilibrium of pressure over the whole of this region. The winds generally show the usual cold-weather direction, the motion of the air being from Upper India to the Bay, over which there was a gentle flow to the south or south-west.

October 21st.—The isobar of 30·00 had during the previous twenty-four hours advanced down the Gangetic plain as far as the great bend of the Ganges, but retreated slightly from the Orissa coast. The pressure in the centre and south of the Bay of Bengal was diminishing during the day. The decrease at Port Blair and Nancowry was ·035″ and at Vizagapatam ·024.″ In Ceylon the pressure on the western coast was slightly greater than on the preceding day, and on the eastern coast at Trincomalee it was ·046″ less. The most important circumstance connected with this decrease of pressure was the re-establishment of south-westerly winds at Nancowry; and along the coast from Chittagong to Vizagapatam the easterly element of the wind became more strongly marked. There was thus around the coast a tendency to a cyclonic motion of the air. The wind velocity, however, continued to be very small, averaging from two to four miles an hour, and was greatest at the embouchure of the Ganges, where the currents down the Assam and Gangetic valleys pass seawards. Also with the re-establishment of the south-westerly current and its extension northwards began a period of almost continuous drizzling rain at Nancowry, Port Blair, and in Ceylon.

October 22nd.—The chart for this day gives the isobars of mean pressure and the wind directions at 10 A.M. In Upper India and the northern half of the Bay the atmospheric state was almost identical with that of the previous day, whilst in the south of the Bay the pressure continued to diminish. At Port Blair the mean pressure for the 22nd was ·022″ less than that of the 21st, whilst at Nancowry it had fallen ·016.″ The pressure at Port Blair was now ·010″ less than Nancowry. This is the first evidence of the commencement of an area of barometric depression to the north-west of Nancowry, which became more and more intense during the next five or six days, and from which the cyclone of the 30th and 31st had its origin. The pressure in Ceylon increased during the day, and it was now from ·05″ to ·09″ above the average. The wind velocity in Upper India and along the western coast and in Ceylon was very small. At Nancowry during this and the next three days it increased from an average of 1½ miles to 3 miles per hour.

October 23rd.—The isobars for this day show a slight increase of pressure in Northern India, the isobar of 30·00 having advanced almost parallel to its former direction 120 miles to the eastward during the preceding 24 hours. The isobar of 29·95, as on the previous day, ran across the Bay from Akyab to Madras. In the south of the Bay the decrease of pressure continued. The fall during the preceding 24 hours at Port Blair was ·019″ and at Nancowry ·022″. It was, however, still slightly in excess at the latter station. The diminution of pressure over the island of Ceylon averaged ·025.″ Thus the area of low pressure still occupied the same position as on the previous day, the baric difference between its centre and Northern India being now considerable, probably ·15″. The wind directions present no new features, except at Port Blair and Nancowry, where they show a tendency towards a cyclonic movement round the area of low pressure.

October 24th.—The chart for this day shows the continuation of the increase of pressure in Northern India. The isobar of 30·00 had advanced still further eastwards and included a small portion of the deltaic area. The pressure over the whole of Upper India was now very largely in excess of its normal amount. The position of the isobar of 29·95 was almost identical with its position on the previous days, the 22nd and 23rd. In the south-east of the Bay there was a slight increase of pressure which was greater at Port Blair than at Nancowry. The mean pressure was also now very slightly greater at Port Blair, but the continuation of the same winds as on the previous day indicates clearly the persistence of the area of depression to the north-west of Nancowry, and the gradual development of a cyclonic movement of the air round this area.

October 25th.—The pressure during the day diminished slightly over the whole of Bengal and Northern India, the isobar of 30·00 now running north-west and south-east from False Point to Patna. The isobar of 29·95 occupied the same position as on the previous days, being a sort of fulcrum, about which the changes of pressure were taking place. The pressure at Port Blair fell ·008, whilst at Nancowry it was increasing. Judging from this and the wind direction at Port Blair and the distribution of pressure on the succeeding days, it is probable that the area of barometric depression had now begun to extend or advance northwards. At all the Ceylon stations, except Trincomalee, there was a slight increase of pressure. Up to this date the north-easterly winds along the west coast of the Bay extended as far south as Ceylon. The wind velocity at the stations along the coast and in Ceylon and Upper India showed the continuance of very moderate breezes up to the evening of this day. The log of the *Tennyson*, which was passing up the Bay, throws some light on the meteorology of the centre of the Bay and the region of diminishing pressure to the north-west of Nancowry. She had light winds from the west and a steady barometer until the 26th, when she was in latitude 13°, and after that date, light breezes and a clear sky until the 29th, when she was overtaken by the cyclone, which had formed in the area over which she had passed three or four days previously. The *Lightning*, passing over this area on the 23rd and 24th, had very hot, but fine weather, with very light winds and occasional showers. The barometers of these vessels have not been compared with the Calcutta standard, but from a rough comparison of their readings when the vessels were passing up the river to Calcutta with the Sagar Island and Calcutta barometers, it is probable that at this period the lowest pressure in the Bay was to the north-west of Nancowry, and was not below 29·85″. The *Forfarshire* was in latitude 11°30′ N. and longitude 90°30′ E. at noon of this day. The reading of her barometer at that hour corrected to the Calcutta standard was 27·879, and on the 28th at noon, when in latitude 18°30′, it was 29·829. This and the fact that no fall of the barometer is noticed in her log, seem to establish conclusively that over the central area the pressure was as yet very slightly less than around the coast, and that its diminution was proceeding at a comparatively slow rate.

October 26th.—The chart of this day presents a continuation of the changes which began on the previous day. The atmospheric pressure was still diminishing over Northern India. It was now less than 30·00″ over the whole of India, except in the eastern part of Assam and to the west of Bareilly and Meerut in the North-West Provinces, and the Punjab. The isobar of 29·95 had also advanced to the west, and now passed through Dacca, to the east of Sagar Island, across the north-western angle of the Bay, meeting the coast again probably midway between Vizagapatam and Madras. In the south of the Bay the pressure at Port Blair continued to indicate diminishing pressure over the adjacent sea area. The fall at Port Blair during the preceding 24 hours had been ·015″. This continued gradual diminution of pressure is partially confirmed by the statement of the captain of the *Tennyson* (advancing northwards about 250 miles to the westward of the Andamans) that his barometer fell on this day two-tenths of an inch. The wind directions at Nancowry (which had now changed from south-west to south-east), at Port Blair, and of the ship *Tennyson*, now define the area of diminishing pressure more exactly. The centre was probably about 180 miles to the north-west of Nancowry, and the lowest pressure probably still exceeded 29·75. To the north and west of this area the winds were undoubtedly north and north-east (as shown by the log of the *Tennyson*), the weather fine and sky unclouded, whilst on the east and south-east the winds were south, south-east, and east, and accompanied with continuous rainfall. In Ceylon the easterly element in the wind during the previous five days began to be replaced by a westerly element, indicating the transition from the north-east winds to westerly and south-westerly winds, which were fully established on the following day over the island. The returns of Port Blair and Nancowry and the Ceylon stations and the log of the *Tennyson* seem to establish the fact that the rainfall was not as yet excessive. The rainfall at Port Blair for this day was ·71″ and at Nancowry ·75″. This was, however, the first day since the 10th on which rain in any considerable amount had fallen at these two stations. The character of the wind was now, however, rapidly changing. Hitherto there had been moderate winds with slight drizzling rain. The wind velocity at Nancowry, which had been 64·0 miles on the 25th (or 2·5 miles per hour) and 48 miles on the 24th, increased on this day to 254·1 miles, giving an average of 10·6 miles per hour. This sudden increase evidently indicates a powerful indraught of saturated air from the south into the region of low pressure. The *City of Venice* was at this time passing along the southern and eastern coasts of Ceylon, and experienced light breezes and heavy rain, with occasional squalls and unsettled weather. The wind velocities for the day at the Ceylon stations indicate the same fact, that in the south-west of the Bay the winds were very moderate, and indicated as yet no violent inrush from this direction.

October 27th.—The chart shows a very general decrease of pressure from the preceding day, averaging in amount over the whole of Northern India from ·04″ to ·05″, and in Eastern Bengal ·025″. The isobar of 29·95″ now passes in a very curved line from False Point to Berhampore, and thence westward to Allahabad; whilst the isobar of 29·90″ occupies the same position as that of 29·95″ did on the 24th and 25th, running across the Bay between Akyab and Madras. The isobar of 29·85″ encloses an area to the north-west of Nancowry, and marks the persistence of the area of diminishing pressure. The meteorology of this portion of the Bay is now partially illustrated by the logs of five vessels—the *Empire of Peace* and *British Sceptre*, which were on the south-east, the *Arabia* in the centre, the *Tennyson* on the north, and the *City of Venice* on the south-west of the area.

The *Empire of Peace* and *British Sceptre* were running north along the meridian of 92°, and were within a few miles from each other on this and the following days; the *British Sceptre* experienced strong breezes during the day and a deluge of rain; whilst the *Empire of Peace* reports thick cloudy weather with much rain, the wind varying from south-west to south-south-west. The rainfall at Nancowry (120 miles to the S.E. of these vessels at noon) was ·88 inches, and at Port Blair 1·92 inches. There was thus during the day heavy rainfall on the south and east quadrants of the area of diminishing pressure. The returns of Port Blair and Nancowry on this and the following days suggest a considerable, but not an excessive, rainfall (accompanied with a strong wind) over the whole of this area. Probably the rainfall at no part of it exceeded two or three inches, and the expression "a deluge of rain" must be taken as descriptive rather of an irregular intermittent violent rainfall, than of one abnormally excessive in amount. The *Arabia*, almost due east of Port Blair at noon and advancing northwards to Calcutta along the meridian of 89°, had constant rain during the day, with a gradual change of wind direction from west through south to south-south-east, as she progressed northwards. The corrected reading of her barometer at noon was 29·512. She was in the same latitude, but at some distance further west than the *Forfarshire* was on the 25th, when the corrected reading of her barometer was 29·829. A considerable diminution of pressure had therefore taken place over this area during the interval. During the morning she experienced two squalls from the north-east, showing the commencement of the rapid indraught of air on the northern side of the region of diminishing pressure. The logs of the *Tennyson* and *Forfarshire*, in latitude 16° and some distance north of the *Arabia*, show the continuation there of the north-east monsoon, with clear weather and a steady moderate breeze. The wind velocities of the coast stations present little change from the 20th, and furnish no evidence of any extensive indraught to the centre or south of the Bay. At Nancowry the velocity was in excess of the previous day, 310·8 miles being registered during the day. This proves the continued indraught into the region of depression, and also what is important, that its centre was still at no great distance from Nancowry, and that it had probably not moved northwards to any considerable distance during the preceding 24 hours. There was a very slight increase in the wind velocities of the Southern Ceylon stations. Some of the wind directions in Northern India seem to be anomalous, but they probably indicate local winds, due to small differences of the pressure, or to slightly different atmospheric conditions over limited areas, and confirm the existence and continuation of the condition of almost uniform atmospheric pressure over the land area.

October 28th.—The chart for this day shows a further diminution of pressure over the whole area north of Nancowry, where the mean pressure was the same as on previous day. The isobar of 29·95 has again advanced up the Gangetic valley, and runs between Lucknow and Agra on one side and Allahabad on the other. The isobar of 29·90 crosses the head of the Bay from Chittagong to the coast south of Vizagapatam. The pressures at Akyab and Chittagong were on this day relatively very low to the adjacent coast stations. The pressure at Port Blair was ·022″ less than on the previous day. This and the readings of the barometer on board the *Arabia* on the previous day prove that the diminution of pressure was now proceeding at a more rapid rate over the area of diminishing pressure to the north-west of the Nicobars and west of the Andamans. The corrected reading of the *Arabia's* barometer at noon of this day was 29·551″ (·039″ higher than on the previous day, indicating that she was then advancing more rapidly northwards than the extension of the area of barometric depression). The pressure along the west coast of Ceylon was still above the average, whilst the variations were small in amount. Along the east and south coast the changes were much larger. The range of the mean barometric pressure at Colombo from the 20th to the 31st was only ·09″, whilst at Trincomalee it was ·16″.

The wind to the south of Ceylon was almost due west, at Nancowry south-west, and at Port Blair and to the west of it, as shown by the logs of the *Allahabad*, *Empire of Peace*, and *British Sceptre*, all within a few miles from each other, south-south-east. The logs of the *Tennyson* and *Forfarshire* state that at the head of the Bay the wind was north-east and the *City of Venice*, to the west of the area of depression, that it was there north-north-east. Thus there was a decided cyclonic circulation round the area of diminishing pressure. The *Arabia*, nearest the centre, had squalls from the S. E., a high sea and constant rain.

The rainfall at Port Blair and Nancowry during the day was not large in amount: ·34 inches were recorded at Port Blair, and ·14 at Nancowry. The ship *British Sceptre* reports torrents of rain, alternately warm and cold; the *Empire of Peace*, strong breezes with much rain; and the *Allahabad*, constant rain with very heavy squalls. These vessels were all to the west of the Andamans on this day. The steamer *Japan*, passing along the east coast of Ceylon, reports squally winds from the west, with light rain. The log of the *City of Venice* for this and the following day is especially interesting, as it shows the gradual change of the weather which preceded and accompanied the formation of the cyclone. Early in the morning there were frequent squalls of wind and rain attended with vivid lightning and heavy thunder. At noon there was a fresh breeze with heavy squalls of wind and rain and a confused sea. At 8 P.M. there was a fresh gale with heavy squalls and a high cross sea, whilst at midnight there were hard squalls with bad-looking weather. The *City of Venice* was during the day to the south-west and west of the centre of the area of low barometer. The *Tennyson* and *Forfarshire*, in latitude 18° N., state that the weather became gradually unsettled during the day, and that a swell set in from the southward which gradually increased in strength. These facts all tend to prove that the area of low barometer and diminishing pressure was extending northwards, that the amount of the depression was steadily increasing, and that over this region of diminishing pressure the weather was rapidly becoming worse; whilst the wind directions and the frequency of squalls show that the disturbance was also acquiring all the characteristics of an extensive and violent cyclone.

The amount of wind registered at Nancowry during the day was only 29·9 miles, confirming the supposition that the centre of the area of depression had advanced considerably to the northwards during the preceding 24 hours. The wind velocity at all the coast stations, including Madras, was very small on this day, giving no indication whatever of the violent squalls in the mid Bay. The wind returns for Galle, Colombo, and Trincomalee show a slight increase of the velocity of the westerly indraught to the region of low pressure.

October 29th.—The chart for this day indicates that a considerable change had taken place in the distribution of pressure in Northern India, over the whole of which it had increased by amounts varying from ·03″ to ·05″.

The isobar of 29·95 is now parallel to the head of the Bay, and at a distance of 150 miles from it. The isobar of 29·90 runs to the south of Akyab and Chittagong, showing increase of pressure at the north-eastern angle of the Bay, whilst it has advanced on the opposite coast as far north as False Point.

The isobar of 29·80 includes a closed area occupying the greater part of the Bay, the centre of which continued to be a region of steadily diminishing pressure. The pressure at Port Blair and Nancowry was ·015 higher than on the preceding day. The centre of this area of depression and atmospheric disturbance, which was increasing by northward extension, as well as by the slow advance of the centre northwards, was on the afternoon of this day probably almost due west of Port Blair. The wind directions given in the chart for 10 A.M. indicate clearly the position of this area and its centre.

The corrected reading of the barometer of the *Arabia* at noon is 29·45. The barometers of the other ships within the disturbed area all indicate decrease of pressure, but do not afford sufficient data to determine the minimum pressure at this period.

The rainfall at Nancowry and Port Blair was still moderate in amount.

The ship *British Sceptre* reports torrents of rain and hard squalls; the *Empire of Peace*, thick rainy weather; and the *Allahabad*, constant rain with very heavy squalls. These vessels were on the north-eastern quadrant of the advancing storm and incipient cyclone. The *City of Venice*, in latitude 14° N. and longitude 85°30′ E., was advancing north with the storm during the early part of the day, and was in the north-western quadrant. She experienced early in the morning a moderate gale with continuous rain, and a high cross sea from the east. At noon the gale was increasing, blowing in hard squalls. The ship was reduced to half speed at 2 P.M. At 4 P.M. and during the remainder of the day the wind blew a hard gale with furious squalls from north-east and north-north-east, and rain, whilst the sea became more and more confused, causing the ship to labour and pitch heavily. The log of the *Arabia*, which was in latitude 14° 19′ N. and longitude 89° 30′ E. at noon, confirms the evidence of the *City of Venice.* She had during the day gloomy weather, a violent wind with strong squalls at intervals, and torrential rain. The atmospheric disturbance was thus rapidly intensifying and developing into a cyclone.

The *Tennyson*, *Forfarshire*, and *Lightning* were all approaching the mouth of the Hooghly, and experienced the gradual northward extension of the disturbance. The *Tennyson*, farthest to the south and in latitude 18°20′ N. at noon, had early in the morning squalls from the east with rain. The weather during the day became worse and the swell from the south increased and rolled up heavily. The *Forfarshire* and *Lightning*, eighty miles further north, had fair weather in the morning with a moderate breeze, but it changed rapidly during the afternoon, becoming unsettled and squally with rain. At Madras there was calm clear weather. The steamer *Japan*, 200 miles to the south-east, had a strong west-north-west wind during the day, cloudy weather with squalls, whilst towards evening there was every appearance of a gale.

The evidence furnished by the logs of the vessels, combined with the observations at the observatories at Port Blair, Nancowry, and the coast stations, establish clearly that the change from the larger and more general disturbance over the greater portion of the Bay and its intensification and development to a cyclone, took place during the afternoon and evening of the 29th and morning of the 30th. This change, moreover, was a mere expansion or development due to the continuance and insistency of the very same causes which had produced the diminishing pressure over the mid Bay, and not to the sudden inrush of a strong current from any neighbouring region south or north. The history of the advance of the cyclone from the morning of the 30th until its final breaking up amongst the Tipperah Hills is given in separate sections.

The following gives briefly the meteorology of the land area to the north of the Bay during the advance of the cyclone on the 30th and 31st up the Bay to the estuary of the Megna:—

October 30th and 31st.—The charts for these days give the synchronous (corrected and reduced) barometer readings and wind directions at the various observing stations, and illustrate the rapid changes of pressure round the coast and in Bengal due to the advancing cyclone. The probable position of the vortex is shown on each chart by a small circle.

The wind directions show clearly the general cyclonic character of the winds at this time over the whole of the Bay of Bengal and Northern India. The wind velocity in the North-West Provinces and Behar was on the 30th small in amount, averaging from half a mile per hour to 2½ miles. It was increasing rapidly at False Point, 161·5 miles being registered. The wind velocity at Sagar Island showed a slight decrease from the previous day. At the land stations in Bengal and Assam there was a slight increase. The wind returns of False Point alone distinctly showed the approach of the cyclone.

The humidity and amount of aqueous vapour in the air increased considerably during the day, and a slight rainfall after a break of nine days occurred in the Burdwan, Presidency, Dacca, and Chittagong Divisions, and on the coast of Orissa and in Assam. In Behar the sky was slightly clouded.

The wind velocities in the North-West Provinces and Behar on the 31st were almost identical with those of the previous day, and indicated very gentle breezes over this part of India. The number of miles registered at False Point was 232·2, and at Sagar Island 527·6, an average of 22 miles per hour. The returns of all the stations round and near the coast in Bengal show increasing velocity of the wind with the approach of the cyclone. The humidity was high during the day, and slight showers of rainfall occurred over the same districts as on the previous day. In no case, however, was the rainfall at all large in amount, the only rainfall exceeding an inch occurring at Khoolna, in the Jessore district. The rainfall at Nancowry on the 30th was 0·53″, and on the 31st 0·32″. For the same two days at Port Blair it was 1·38″ and 0·31″ respectively.

The pressure diminished over the whole of Ceylon on the 30th by amounts varying from ·009″ to ·061″, the fall being greatest at Colombo. It increased on the 31st at all stations except along the north-east. The wind during this period was from the west and south-west, the velocity at the coast stations showing a slight increase on the 31st. The greatest amount was recorded at Galle on the 31st, when 257·5 miles were registered.

CHAPTER III.

The Path of the Cyclone in the Bay of Bengal.

The preceding section has shown that from the 21st a state of circumstances such as I conceive to be favourable to the formation of a cyclone had prevailed over the Bay. There was great uniformity of pressure on that date over the whole of the Bay, whilst the moderate north-east and south-west winds which were blowing on opposite sides of it prevented the dispersion of the aqueous vapour in the lower atmospheric strata towards the neighbouring regions, more especially the land area of Southern India. This had been followed from the 23rd by the formation of a region of diminishing pressure in the Bay to the north-west of the Nicobars, and by rapid condensation of vapour over that part of the area of evaporation which was to the south and south-east of the centre of the region of barometric depression. This state of things continued, and gradually intensified in character; the weather became more unsettled and squally, the rainfall on the south-eastern quadrant increased, whilst a strong indraught set in from the south-west on the 27th and 28th, and a weaker indraught on the north. These are all proofs that the area of diminishing pressure gradually extended northwards, and that the amount of the depression increased, at first slowly, and afterwards with accelerating rapidity, owing to the prolonged persistence of the causes and the accumulation of the effects. The centre of the area of depression was probably in latitude 10° N. and longitude 89° E. on the 27th, and was then moving very slowly northwards. It was in latitude 13° N. and longitude 89° E. at noon of the 29th. There was a gale, cyclonic in its character, on this day in the area of depression, but the true cyclone appears to have been the further concentration of this cyclonic motion on the evening of the 29th and morning of the 30th. All the circumstances which had favoured the formation of the cyclonic disturbance up to the 29th still continued, and it is probable that the true cyclone, although formed on the evening of the 29th, did not acquire its full intensity until the afternoon of the 30th.

The S. S. *Japan* on the evening of the 29th, in latitude 11° N. and longitude 84° E., experienced a moderate gale and squally weather with heavy rain. She was at this time running parallel to the path of the cyclonic disturbance. The slight changes of wind (west-north-west to west) show that she was in the south-western quadrant at a very considerable distance from the centre. During the early part of the morning of the 30th she apparently was advancing northwards more rapidly than the cyclone, and approaching it, for at 7 A.M. the gale was freshening and the ship labouring from the heavy confused sea. There was also a very heavy bank of clouds forming to the north and north-east. The engines were then eased to dead slow until 5-30 P.M., during which the gale gradually moderated. They were again set at full speed at 6-30 P.M. The ship was now well in the rear of the storm, and the weather slowly improved. The *Japan* was probably nearest the centre at noon of the 30th, when in latitude 12° 9′ N. and longitude 85° 30′ E., but the very slight fall of the barometer during the previous 36 hours show that she was at a very considerable distance from the vortex. The centre was then to the north-east, and probably at a distance of 270 miles. This would give its position at noon of the 30th as in latitude 14° 30′ and longitude 89° 15′.

The log of the S. S. *City of Venice* shows that she was within the outer limits of the area of cyclonic disturbance on the evening of the 29th and the morning of the 30th. At midnight of the 29th she was steaming very slowly north (in latitude 14° 40′ N. and longitude 85° 35′ E) amidst a hard gale, the force of which varied from 7 to 9, with fierce squalls of rain and spray. At 9-20 A.M. of the 30th the weather was so threatening that the ship's head was turned to the south-west for several hours, and she rapidly passed away from the cyclonic area. At 2-30 P.M. the ship was brought to and turned to the north-east. She then advanced almost parallel to the path of the cyclone, and continued for the remainder of the day in its outer limits. The changes of the wind and the barometric readings indicate that she was nearest the centre at midday of the 30th. The vortex was at this time probably almost due east, and in latitude 14° 30′ and longitude 89° 10′, assuming, from the amount of the fall of the barometer, that the vessel was 210 miles from the centre. The logs of these two vessels thus give approximate positions for the centre substantially agreeing with and confirming each other.

The S. S. *Penang* is the next vessel in order of time which was involved in the cyclone. She was steaming southwards, having left Calcutta on the 28th, and was rapidly approaching the cyclone on the 30th, experiencing rough weather during the greater part of the day. The wind increased rapidly during the evening. The sea broke over the vessel, washed away the starboard cutter and burst open the starboard saloon door, flooding the saloon with water early in the evening at 8 P.M. The barometer continued to fall until 4 A.M. of the 31st, from which to 7-30 A.M. it varied very little. At 7-30 A.M. the whole of the front of the saloon was stove in, and the ship lay like a log, with the saloon full of water, whilst the sea continued to break over her and reduced her to a perfect wreck on deck. The weather began to moderate from this time, and the cyclone passed on, leaving the *Penang* in so disabled a state as to be compelled to return to Calcutta. Her position at the worst of the cyclone is stated in the log to have been 17° 30′ N. and 86° 50′ E. If this position is correct, the position of the vortex can be approximately ascertained on the morning of the 31st. As no readings of the barometer are given for the day on which the *Penang* left Calcutta, it is impossible to ascertain even roughly whether the instrument was comparable with the Calcutta standard, or what its error was. The slight fall of her barometer from 2-30 A.M. of the 30th to 4 A.M. of the 31st (·18″) shows that she was at least 150 to 160 miles distant from the vortex, which was therefore in latitude 17° 45′ N. and longitude 89° 15′ E. at 7-30 A.M. of the 31st. This would give an average rate of advance from midday of the 30th of nearly nine miles per hour.

The *Scottish Chieftain* arrived at the head of the Bay on the 29th, and was unable to obtain a pilot on account of the heavy sea. She stood off to the south-east on the 30th. The gale increased rapidly in violence: the reading of the barometer at midnight, corrected to Calcutta, was 29·578. The wind at this time came from north-east. The barometer fell very quickly from midnight to 3 A.M. of the 31st, when the corrected reading was 29·161. The vessel was then in the north-western quadrant, and stood off to the south-west to avoid the centre. From 4 A.M. the wind blew in terrific squalls accompanied with constant rain, and at 10 A.M. was blowing a hurricane from the north. Shortly after this, at 11-30 A.M., it was found necessary to cut away the fore-topmast backstays, when the fore-topmast went over, carrying with it the main-topmast, mizzen, and topgallant masts. The barometer at midday fell to 28·962, about which time the centre of the cyclone was passing to the east of the vessel, probably in latitude 18° N. and longitude 89° E. The wind at 4 P.M. was from north-north-west, and the barometer rising; the wind backed to the west at 8 P.M., after which the weather rapidly moderated. In this case, as in the logs of the pilot vessels the *Foam* and *Coleroon*, no latitude observations were taken during the storm, and hence their logs are mainly useful in confirming the path assigned to the cyclone from the logs of other vessels.

The log of the *Tennyson* gives the next position of the centre of the cyclone in order of time. She was proceeding towards the mouth of the Hooghly along the meridian of 89°, and was overtaken by the cyclone late on the evening of the 30th. The fall of the barometer up to the afternoon of the 30th had been so slight as to give no indication of the impending cyclone. The increasing swell from the south and the threatening appearance of the sky were the first signs of its approach. The wind was strong during the whole day from east-north-east, and at 10 P.M. began to blow in furious gusts. This was followed by rain in torrents for an hour, succeeded by a few minutes' calm, during which the confused sea was tumbling about in heaps in all directions. The first burst of the cyclone passed over the vessel with a roar like thunder, throwing the ship on her beam-ends until the first rush was past, when she righted. The barometer at midnight stood at 29·6, and fell rapidly with the advance of the cyclone until 1-30 P.M. of the 30th, when it was 28·15. During the earlier part of the cyclone, when the wind was comparatively steady, the *Tennyson* suffered very little damage from the heavy sea; but on the near approach of the vortex, with the more rapid changes of wind and the confused sea, the sails were torn from the gaskets, the ballast shifted, and the vessel thrown on to her beam-ends, the sea washing over her and sweeping off everything on deck. As no mention is made of any prolonged interval of calm during the cyclone, the great fall of the barometer indicates that the vessel was from 15 to 20 miles distant from the central area of calm, which, judging from the changes of wind direction, must have been to the east of the ship. From the assigned positions of the vessel at noon of the 30th and on the 1st the vortex of the storm was very approximately in latitude 18° 45′ N. and longitude 89° 25′ E. at 1 P.M. of the 31st. This would give an average rate of advance of nearly 12 miles during the preceding six hours, so that the velocity of the vortex was increasing as it advanced northwards.

The *Annie Fleming*, *Forfarshire*, and *Lightning* were near the vortex at 4 P.M.

The *Annie Fleming* was in the neighbourhood of the Eastern Channel Light-ship on the 29th, but as she could obtain no pilot, the captain put the ship's head to the south on the 30th to obtain sea room during the gale, which was evidently approaching. At midnight there was every appearance of a severe storm. The barometer fell rapidly, the corrected reading at 8 P.M. of the 30th being 29·151 and at 4 A.M. of the 31st 28·754. The wind was now of hurricane force and accompanied with dense heavy rain. Her barometer fell to 28·455 at 2 P.M., and remained at this height until 4 P.M., during which interval the violence of the storm, ushered in at 2 P.M. by a terrific burst of wind, had carried away the sails and thrown the ship on her beam-ends. The position of the ship on the 1st was 18° 59′ N. and longitude 88° 24′ E. She probably had drifted some distance south and east during the passage of the cyclone. She was nearest the centre about 3 P.M., and the position, 19° 10′ or 19° 15′ N. and longitude 89° 30′ E. for the centre at that time obtained from these considerations, agrees closely with its subsequent position at 4 P.M. as obtained from the log of the *Forfarshire*.

The *Forfarshire*, which was passing up the middle of the Bay, was in latitude 20° 19′ N. and longitude 88° 55′ E. at noon of the 30th, the wind being from east to south-east. She was then approaching the Eastern Channel Light-ship. She experienced heavy squalls and a strong gale during the day. The wind continued to increase during the night and the morning of the 31st. At 11-30 A.M. it was blowing with great fury. The ship before this had stood to the southward under shortened sails, but at 11-30 A.M. lay to under bare poles. The ship's position at noon was latitude 19° 30′ N. and longitude 88° 30′ E. The barometer was lowest between 4 and 5 P.M., reading at that time 28·40, or, reduced for temperature and corrected to the Calcutta standard, 28·436″. The vessel, which had probably drifted to the southward during the previous four hours, was then within 45 miles from the vortex, the position of which at 4 P.M. was thus approximately 19° 20′ and longitude 89° 25′, giving a velocity of 13 miles during the interval from the time when its centre passed to the east of the *Tennyson* to 4 P.M.

The *Lightning* arrived at the head of the Bay on the morning of the 30th. As the weather looked unsettled, she stood out to the south-east. The gale increased during the day. Her barometer, which at noon of the 30th stood at 29·90, fell until 3-30 P.M. of the 31st, when it read 28·90. The storm was at its worst between midday of Tuesday and 6 P.M., during which time the starboard and port life-boats were cut away, and the mainsail, mizzen-topgallant sail, and lower fore-topsail were blown away by the wind. The ship was in the westerly quadrant of the cyclone. Her position at noon of the 31st was in latitude 19° 46′ N. and longitude 88° 31′ E. Allowing for the southerly current, the probable position of the vessel at the worst of the cyclone (3-30 P.M.) was 19° 25′ N. latitude and 88° 30′ E. longitude. This would assign the position of the storm centre at this time as in latitude 19° 20′ N. and longitude 89° 30′ E., agreeing very nearly with that obtained from the logs of the *Annie Fleming* and *Forfarshire*.

The *Octavia*, *British Statesman*, and the *Palmas* were very near to the path of the vortex about 6 P.M. of the 31st.

The *Octavia* was on the 29th sailing northwards to Calcutta, being at noon in latitude 19° 33′ N. and longitude 90° 14′ E. She experienced heavy rains and variable winds during the afternoon. A whirlwind and waterspout passed near the vessel at 3 P.M., due to the same causes as the larger cyclonic disturbance further south. The weather became rapidly worse on the 30th, and towards evening the vessel, which was now near the light-ship, turned southwards to obtain a safe offing. The barometer stood at 29·8 at 2 A.M. of the 31st, and fell rapidly during the day, reaching its lowest at 6-30 P.M., when it read 28·15. The vessel had drifted to the south-east towards the storm centre, and was at this time probably not more than 20 miles to the west of the vortex. The wind blew with hurricane force from noon, carrying away the sails and masts. The barometers and other instruments were broken to pieces by a wave which swept over the ship and washed them overboard. The storm began to abate at 8 P.M., so that the vessel appears to have been nearest to the vortex from 6 P.M. to 7 P.M. The lowest reading of the barometer on board the *British Statesman* was 28·2″, taken at 6 P.M. These two vessels were probably within a few miles from each other. There is nothing in the logs of either vessel from which their exact position at the height of the storm can be assigned. Judging from the position of the vessels before the storm and the current southwards, the *Octavia* was probably in latitude 19° 45′ or 20° N. and longitude 89° 40′ at 6 P.M., when the storm vortex passed a few miles to the east. The position of the vortex on this supposition would therefore be at this time in latitude 19° 45′ N. and longitude 89° 50′ or 90° E., giving a rate of advance of nearly 15 miles an hour during the preceding two hours in a north-north-east direction.

The *Palmas* on the evening of the 30th was in the neighbourhood of the Eastern Channel Light-ship. The threatening weather induced the captain to put off to the south and prepare for the approaching storm. At noon of the 31st the position of the vessel by account was latitude 19 °50′ N. and longitude 88° 50′ E. Her barometer had fallen from 29·80 at midnight to 28·70 at 12 A.M. of the 31st. It continued to fall, and was at its lowest at 6 P.M., when it read 28·20. The vessel at this time was probably in latitude 19° 40′ N. and longitude 89° 10′ E., and at a distance of 20 or 30 miles from the centre. This would give the position 19° 40′ and 89° 40′ for the centre at 6 P.M., agreeing very closely with the positions as determined from the logs of the *Annie Fleming* and *Forfarshire*, allowing for its north-north-east advance during the interval.

The last vessel in order of time which was within a few miles from the storm centre in its passage up the Bay was the steamer *Moulmein*, proceeding from Chittagong to Calcutta. She left the former port on the 30th, and had a light northerly wind with a southerly swell during that day. The stormy weather did not extend to this corner of the Bay until the morning of the 31st. The barometer at 3 A.M. read 29·70, and fell to 29·53 by midday. The wind was then steady from the north-east, but rapidly increasing in intensity. The ship was at this time in latitude 21° N. and longitude 90° 17′ E. The foretopmast was carried away at 5 P.M., and the foremast at 7 P.M., at which time the spray was carried right over the ship. The lowest reading of the barometer was taken at 8 P.M., when it stood at 28·4″. The centre of the cyclone was then passing to the east of the vessel between 8 and 9 P.M., and at a distance of from 40 to 50 miles. The *Moulmein* was at this time probably in latitude 20° 30′ N. and longitude 89° 35′ E., as her position at noon of the 1st, before she had resumed her voyage to Calcutta, was latitude 20° 20′ N. and longitude 89° 10′ E. The cyclone was therefore in latitude 20° 25′ N. and longitude 90° or 90° 15′ E. at 8-30 P.M., and was advancing now at a rate of nearly 18 miles per hour. The returns from the islands at the mouth of the Megna show that the centre passed over them between 3 A.M. and 4 A.M. of the 1st. They are in latitude 22° 35′ N. and longitude 91° E. This gives during the last seven hours of its advance up the Bay an average velocity of nearly 22 miles. This is so very much greater than the velocity of advance of the majority of cyclones in the Bay, which very rarely exceeds 12 miles per hour, as to form one of the most important characteristics of the cyclone. Whether this unusually high velocity has any connection with the other abnormal feature of the cyclone, the easterly element in its course, I am as yet unable to say.

The log of the French ship *Arabia* presents so many difficulties as to make it almost impossible to determine her varying position relative to the cyclone. Assuming that the log is recorded in nautical time, she was in latitude 11° 50′ N. and longitude 89° 30′ E. on the 28th, and therefore near the middle of the area of barometric depression, but to the east of the line of advance of the vortex on the 30th and 31st. Her log states that on the evening of the 27th she had incessant rain, a strong breeze, and a very high sea, and that from that time the weather became rapidly worse. On the 29th the weather was gloomy and threatening, and in the morning there was torrential rain. On the morning of the 30th the wind came in strong squalls, succeeding each other at short intervals. At midday she was in latitude 16° 6′ N. and longitude 89° 27′ E., and had a strong south-east wind, indicating that she was on the north-eastern quadrant of the advancing cyclone. On the evening of the 30th the wind blew in terrific squalls, and the waves swept over the vessel from stem to stern. At midday of the 31st the violence of the storm threw the ship on her beam-ends, and at 2-30 P.M. it was necessary to cut away the mainmast. Her barometer appears to have been lowest at 8 P.M. on the 31st, when the correct reading was 28·767. No latitude observation was taken on the 31st. Her position at noon of the 1st was 19° 15′ N. latitude and 89° 17′ E. longitude. The only change of wind noted on the 31st is from south-east to north-west. This would seem to indicate that the vessel had passed round from the north-east to the south-west quadrant of the cyclone. From noon of the 30th to noon of the 1st, although only sailing north-east at the rate of a knot per hour, she had advanced from latitude 16° 6′ N. to latitude 19° 15′ N., notwithstanding that for some hours before noon of the 1st she must have drifted to the south under the action of the retreating mass of the storm-wave waters. The only supposition which will explain her assigned positions is that she drifted northwards with the advancing cyclone on the 30th and 31st, and was carried round by the force of the wind and current in front of the advancing cyclone from the north-eastern quadrant to the western and south-western quadrant during the afternoon of the 31st.

If this explanation, the only one I can suggest, be the true one, then the *Arabia* at 8 P.M. of the 31st, when her barometer indicated that she was nearest the centre, must have been in latitude 20° 30′ N., and consequently have been carried a very considerable distance south during the next eight or ten hours, to account for her position at noon on the 1st.

The remaining logs are those of vessels which were in the upper part of the Bay during the cyclone, but at a considerable distance from the path of the vortex. They serve to confirm the accuracy of the assigned line of advance of the centre as determined from the logs of the vessels already discussed.

The S. S. *Busheer* was in the eastern quadrant at midday of the 31st in latitude 17° 45′ N. and longitude 92° 30 E., and at a distance of about 220 miles from the vortex. Her log is especially valuable, as it throws considerable light upon the character of the indraught on the outskirts of the southern and eastern quadrants. Early on the morning of the 31st she had terrific squalls from the south-east, with blinding rain at 7 A.M. They increased in violence and became of cyclonic intensity at 10 A.M. There was a lull of a few minutes at 0·30 P.M., followed by a return of the cylone in full force from the east-south-east and south-east, with incessant terrific gusts which continued to be accompanied by blinding rain.

The excessive rainfall on the south-eastern quadrant is confirmed by the logs of the *Empire of Peace*, *Allahabad*, and *Neva*, all of which were in positions near latitude 20° and longitude 92° E. when the cyclone centre passed to the west of them about 10 P.M.

The *Empire of Peace* was in latitude 19° 30′ N. and longitude 91° 20′ E. at noon of the 31st. During the previous day the wind had blown a gale from the east-south-east, and was accompanied with heavy rain. The barometer fell to 29·18 at 6 P.M., and from that time to 10 P.M. she felt the full violence of the storm.

The *Allahabad* was in latitude 19° 10′ N. and longitude 90° 48′ E. by account at noon of the 31st or at midnight of the 30th; the time is not clearly stated and appears from the log to be the latter. The corrected reading of her barometer at that time was 29·711″. The lowest reading was 28·945 (corrected to the Calcutta standard) from 8 P.M. to 10 P.M. of the 31st. During the whole day there was constant rain. The exact positions of these ships are somewhat uncertain, as during the cyclone there was, as the captain of the *Allahabad* remarks, a strong current to the north-east on the eastern quadrant of the cylone, whilst on the morning of the 1st, with the retreat of the waters of the storm-wave southwards, there was a very strong current in the opposite direction. The position of the ship at the worst of the storm was probably latitude 21° N. and longitude 91° 30′ E., which would agree closely with its position as determined from the fall of her barometer and the position of the storm centre as previously obtained.

The *Neva* was in latitude 19° 21′ N. and longitude 91° 33′ at noon of the 31st, and therefore within a few miles from the *Empire of Peace* and *Allahabad*. Her captain notes that on the morning of the 31st the heavy squalls were accompanied with torrents of rain. The wind, which at 4 P.M. was blowing a hurricane, continued to increase in violence during the evening. At 11 P.M. he reports that the wind was then blowing a terrific hurricane with tremendous gusts, accompanied with torrents of rain, and spray blown from the tops of the waves, which were at this time very high. She was nearest the centre between 10 P.M. and midnight of the 31st. Her position at noon of the 1st, after she had drifted south under the action of the return current due to the storm-wave, was 20° 33′ N. latitude and 91° 7′ E. longitude. She was probably in latitude 21° 15′ N. and longitude 91° 20′ E. at the worst of the storm.

The logs of the remaining vessels throw no additional light on the path of the vortex, and it is therefore unnecessary to discuss them *seriatim*. The following table gives the probable position of the vessels whose logs are recorded in Chapter I when they were nearest to the storm vortex, their distance and bearing from it, with a brief summary of the damage caused by the storm.

Vessel.	For log see page	Latitude when nearest.	Longitude.	Lowest reading of barometer (uncorrected).	Distance from and bearing of centre.	Time when nearest.	Remarks.
					Miles.		
S. S. City of Venice	80	14° 40′ N.	85° 15′ E.	29·45	210 E.	30th, 10 A.M.	Ship at 9-20 A.M. of 30th. Found gale so severe that she was turned round to south-west for several hours.
„ Japan ...	97	12° 10′	85° 30′	29·65	270 N. E.	30th, 12 „	Fresh gale with heavy squalls and showery weather. Engines at dead slow from 7-20 A.M. to 6-20 P.M.
„ Penang ...	108	17° 30′	86° 50′	29·32	150 E.	31st, 4 to 7-30 A.M.	Boats washed away; sails carried away; ship a perfect wreck on deck and obliged to return to Calcutta.
Bushire	118	17° 45′	92° 30′	29·52	220 N. W.	31st, 12 A.M.	
Scottish Chieftain ...	115	18° 50′	88° 10′	29·00	90 E.	31st, 12 „	Fore-topmast, main-topmast, and mizzen-topgallant mast carried away.
Tennyson	92	18° 40′	89° 10′	28·15	20 E.	31st, 1-30 P.M.	Sails blown away; ship a wreck on deck.
Foam	117	19° 0′	87° 5′	29·10	100 E.	31st, 2 „	
Annie Fleming ...	109	18° 55′	88° 20′	28·50	50 to 60	31st, 4 „	Sails carried away; ballast shifted.
Lightning	104	19° 25′	88° 30′	28·95	65	31st, 3-30 „	Port life-boat and starboard life-boat cut away; main sail, mizzen-topgallant sail carried away.
Thessalus	113	19° 40′	88° 10′	29·05	90 E.	31st, 4 „	Top-sails blown away; main-topgallant mast carried away.
Forfarshire	103	19° 20′	88° 30′	28·40	45 E.	31st, 4-30 „	Wind blew sails out of gaskets; three topgallant masts carried away.
Coleroon	113	19° 45′	87° 30′	29·25	125 E.	31st, 5 „	
Lady Octavia ...	94	19° 45′	89° 40′	28·15	20 to 25 E.	31st, 6 „	Sails carried away or blown to pieces; fore-gallant mast, mizzen-topgallant mast, starboard life-boat swept away; deck gear all washed away.
Palmas	111	19° 45′	89° 10′	28·20	35 E.	31st, 6 „	Ballast shifted; masts cut away; starboard anchor let go; sails blown and torn out of gaskets.
Allahabad	103	21°	91° 30′	28·90	80 N.N.W.	31st, 9 „	Sails torn from gaskets; canvas in mizzen-rigging blown away.
Clarence	110	20° 30′	88° 10′	29·10	100 E.	31st, 6 „	
British Sceptre ...	94	19° 50′	91° 25′	29·22	110 N.N.W.	31st, 6 to 8 „	Foresail and main topsail split.
Planet	120	......	....	28·80	60 E.	1st, 2 A M.	
British Statesman ...	110	20° 10	89° 30′	28·20	20 E.	31st, 8 „	Sails blown away; topgallant mast, topmast, fore, and mainmast carried and cut away.
Arabia	89	20° 30′	......	28·77	60	31st, 8 P M.	Mainmast cut away; sails carried away by the wind.
Moulmein	116	20° 30′	89° 35′	28·40	45 S. S. E.	31st, 8 to 9 „	Foremast, main topmast, and funnel carried away.
Empire of Peace ...	88	20° 20′	91° 30′	29·18	95 N.N.W.	31st, 9 „	Lower main topsail split, fore topgallant mast cut away, main and mizzen topgallant blown away, and rudder-head gave way.
Neva...	119	21° 15′	91° 20′	29·05	85 W.N.W.	31st, 11 „	Lower mizzen topsail, upper and lower fore-topsail, foresail, cross-jack, mizzen-topgallant sail, and main and mizzen topgallant staysails all blown away.

The following are the barometric readings taken on board of the vessels, the barometers of which were compared with the Calcutta standard after their arrival in the Port of Calcutta:—

Ship's Name.	Date and Hour.	Barometer.		Barometer reduced and corrected.	Wind direction.	Ship's position.	
		Observed.	Attached Thermometer.			Latitude.	Longitude.
Forfarshire ...	October.						
	25th, 12 h. ...	29·850	......	29·879	......	11° 30′ N.	90° 30′ E.
	28th, 12 h. ...	·800	......	29·829	N. E. to E. & S.E.	18° 30′	88° 23′
	29th ...	......	......	......	Easterly.		
	30th, 12 h. ...	29·750	......	29·779	E. to S E.	20° 19′	88° 55′
	30th, 24 h. ...	·600	......	·631	N. E. by E.		
	31st ...	......	......	......	N. E.		
	31st, 12 h. ...	29·200	......	29·232	......	19° 30′	88° 30′
	31st, between 4 and 5 P.M.	28·400	......	28·436	Cyclone raging with its utmost fury.		
	31st, about 5 P.M....	......	......	......	N. & N. N. W.		
	November.						
	31st ...	29·800	......	29·829	From W. to S. W.		
Scottish Chieftain	October.						
	29th ...	......	......	......	N. E.		
	29th, 7-30 P.M. ...	......	......	......	E. N. E. to S. E.		
	30th ...	29·800	......	29·758	N. E.		
	30th, 4 P.M. ...	......	......	......	N. E.		
	30th, 8 „ to midnight.	·620	......	29 578			
	31st, 3 A.M. ...	·200	......	·161			
	31st, 10 „ ...	·100	......	·062	N.		
	31st, noon ...	·000	......	28·962			
	31st, 4 P.M. ...	·100	......	29·062	N. N. W.		
Thessalus ...	October.						
	30th, 8 A.M. ...	30·000	80	29·852	E.	20° 28′	90° 55′
	30th, 10 „ ...	·026	......	·878			
	30th, noon ...	29·962	81·1	·811	E. by N.		
	30th, 4 P.M.	·886	82	·734	N. E.		
	30th, 8 „ ...	·908	81	·768	N. E.		
	30th, midnight ...	·826	80·2	·679	N. E.		
	31st, 4 A.M. ...	·740	80·2	·593	N. E.		
	31st, 8 „ ...	·600	79·1	·457	N. E. by N.		
	31st, noon ...	·400	......	·255	N. E. by N.		
	31st, 4 P.M. ...	050	......	28·907	N. by E.		
	31st, 8 „ ...	·420	......	29·274	N. or N. N. W.		
	31st, midnight ...	·700	......	·554	N W. or W. N. W.		
	November.						
	1st, 4 A.M. ...	·810	......	·663	......	19° 52′	87° 54′
	1st, 8 „ ...	·930	......	·782			
Foam	October.						
	30th, 1 h. ...	29·96	83	29·735	Calm.		
	30th, 2 h. ...	·94	83	·715	Light airs from N.E.		
	30th, 3 h. ...	·94	84	·715			
	30th, 4 h. ...	94	84	·712			
	30th, 6 h. ...	·92	84	·692	N. N. E.		
	30th, 8 h. ...	30·00	85	·771	N. E.		
	30th, 10 h. ...	29·96	85	·730	N. E.		
	30th, 12 h. ...	·98	86	746	N. E.		
	30th, 14 h. ...	·94	84	·715			
	30th, 16 h. ...	·79	82	·568			
	30th, 18 h. ...	·78	82	·558			
	30th, 20 h. ...	·79	82	·568			
	30th, 22 h. ...	·80	82	·578			
	30th, 24 h. ...	·82	82	·598			
	31st, 2 h. ...	29·67	......	29·449	N.E.N. N.E. at 9 h.		
	31st, 11·30 h. ...	·24	......	·021	N.		
	31st, 12 h. ...	·20	......	28·982	N.		
	31st, 14 h. ...	·10	......	·882	N. N. W.		
	31st, 15-37 h. ...	·2	......	·982	N. W.		
	31st, 16 h. ...	·5	......	29·279	N. W.		
	31st, 17 h. ...	·27	......	·052	W. N. W.		
	31st, 18 h. ...	·33	......	·112	W. N. W.		
	31st, 19 h. ...	·45	......	·283	W.		
	31st, 20 h. ...	·50	......	·282	W.		
	31st, 22 h. ...	·62	......	·402	W.		
	31st, 24 h. ...	·70	......	·482	W.		
	November.						
	1st, 2 h. ...	72	81	·501			
	1st, 4 h. ...	·73	81	·511	W.		
	1st, 6 h. ...	·80	85	·570	W.		
	1st, 8 h. ...	·86	86	·627	W. N. W.		
	1st, 10 h. ...	·90	82	·678			
	1st, 12 h. ...	·89	83	·665	N. W. by N.		

SHIP'S NAME.	Date and Hour.	BAROMETER.		Barometer reduced and corrected.	Wind direction.	SHIP'S POSITION.	
		Observed.	Attached Thermometer.			Latitude.	Longitude.
	November.						
Foam	1st, 14 h.	29·86	84	29·633	W. N. W.		
	1st, 16 h.	·84	84	·613			
	1st, 18 h.	·85	83	·625			
	1st, 20 h.	·87	83	·645	N. W. by N.		
	1st, 22 h.	·90	83	·675			
	1st, 24 h.	·99	83	·765			
	October.						
Arabia	28th, noon	29·725	......	29·512	......	11° 50′	89° 01′
	29th	·764	......	·551	......	14° 19′	89° 30′
	30th	·646	......	·433	......	16° 06′	89° 27′
	31st	·410	......	·198			
	31st, 4 P.M.	·134	......	28·924	......	19° 15′	89° 17
	31st, 8 „	28·977	......	·767			
	1st, 1 A.M.	29·134	......	·924			
	1st, 5 „	·449	......	29·237			
	October.						
Allahabad	28th	·70	79	29·744	S. S. E to S.	12° 4′ N.	91° 0 E.
	29th	·70	81	·738	S. E.	14° 53′	92° 10′
	30th	·70	80	·741	S. to E.	17° 57′	91° 40′
	30th, midnight (?)	·67	80	·711	......	19° 10′	90° 48′
	31st, noon	·45	......	·492			
	31st, 2 P.M.	·30	......	·342			
	31st, 4 „	·20	......	·243			
	31st, 6 „	·10	......	·144			
	31st, 8 „	28·90	......	28·945	S. E.		
	31st, 10 „	·90	......	·945	S. S E. to S.		
	31st, midnight	29·20	......	29·243	S. S. W.	20° 13′	91° 40′
	November.						
	1st, 1 A.M.	......	......	......	W. S. W.		
	1st, noon	·80	......	·840			
	October.	Aner. Bar.		Aner. Bar.			
Clarence	30th, noon	... ...	......	... ...	N. E.		
	31st, midnight	... ...	......	... ...	N. E.		
	31st, 4 A.M.	... ...	......	... ...	N. E. by N.		
	31st, noon	29·35 29·40	81	29·362 29·324	N. N. E.		
	November.						
	1st	... ·15	......	... ·078	N.		
	1st, 6 P.M.	... ·10	......	... ·029	N. N. W.		
	1st, midnight	... ·30	......	... ·227			
	1st, noon	... ·80	81	... ·725	W.	20° 2′	88° 20′
	October.						
Annie Fleming	30th	29·60					
	30th	·50	......	29·450	E. N. E.		
	30th, 4 P.M.	......	......	......	E. by S. to E. N.E.		
	30th, 8 „	29·20	......	·151			
	31st, 4 A.M.	28·80	......	28·754			
	31st, 7 „	60	......	·555			
	31st, 2 P.M.	50	......	·455			
	31st, 4 „	50	......	·455	N.		
	November.						
	1st	......	......	......	......	18° 59′	88° 24′
	2nd	......	......	......	......	19° 5′	88° 25′

The following points, which are of importance in the meteorological discussion of the question, seem to me to be fully established by the discussion in this and the preceding chapters—

(1)—That for some days after the 20th there was fine unclouded weather over the whole of the Bay, with moderate winds and very slight differences of pressure.

(2)—That the stormy weather and rain squalls commenced in the south of the Bay and gradually extended northwards and became more violent, at first gradually, but afterwards with increasing rapidity, and that this was accompanied by a diminution of atmospheric pressure similar in character—that is, the diminution at first proceeded slowly, and afterwards more and more rapidly with the persistence of the causes.

(3)—That nowhere round the limits of the Bay were the winds during the whole of this period of such a character as to indicate an excessive indraught from any region external to the area of diminishing pressure and stormy weather. The slight increase of velocity which occurred round the south-western limits, more especially in Ceylon, was such as can be most easily explained by the supposition of an increasing internal action in the Bay followed by convergence of the winds from the outer limits. The Nancowry returns and the logs of the vessels, moreover, appear to show conclusively that the wind motion was from the first strongest near the centre and gradually decreased in violence towards the limits of the Bay.

(4)—That the cyclone proper was preceded by a more general cyclonic movement around the Bay, due to meteorological conditions and action beyond the Bay.

(5)—That the development of the cyclone proper was, however, due to causes and action confined almost entirely to the Bay, originating and intensifying there without exercising any marked effect on the meteorology of the coast districts until it was fully formed and proceeding towards the head of the Bay. Hence the immediate causes of the cyclone formation and action must be sought for in the meteorology of the Bay itself during this period.

(6)—That the cyclone atmospheric action and motion was probably confined almost entirely to the lower strata of the atmosphere. During this cyclone period, from the 3rd to the 31st, the wind velocities of the two elevated stations in Ceylon—Kandy and Newara Elya—were remarkably small, indicating almost perfect atmospheric equilibrium and calm in the higher strata. This supposition is, however, chiefly established by the fact that the Tipperah hills formed an effective barrier to the cyclone, not merely disintegrating and breaking up the cyclone vortex in the lowest atmospheric strata, but completely dissolving and terminating the general atmospheric disturbance, of which the cyclone proper was the most marked feature.

CHAPTER IV.

Progress of the Cyclone over Eastern Bengal.

THE account of the advance of the cyclone after it reached the mouth of the Megna is very brief, as its further progress inland was prevented by the Tipperah Hills, which speedily broke it up. The materials for investigating its path are very meagre, as the districts to the north-east of Noakholly are thinly populated. I shall first of all trace the path from the information supplied by the various district officers who have assisted me, as far as was possible under the peculiar circumstances, to obtain accurate information. This will be followed by a table giving a summary of the changes of wind direction in the area more or less affected by the storm, and by a series of observations taken during the storm at the Government observatories at Chittagong, Saugor Island, and Calcutta, and on board the steamer *Prince Albert*, lying near Goalundo.

The following table, drawn up by Baboo Sreenath Ghose, Manager under the Court of Wards, gives in a brief form the most important facts respecting the cyclone when it struck the coast at the mouth of the Megna:—

	Height of inundation in feet.	Duration and time of wind from north and north-east.	Duration and time of wind from east.	Duration and time of lull.	Duration and time of wind from west.	Time and duration of inundation, and time of subsidence.	Time of end of storm.	REMARKS.
South Bamni	9 to 17 ...	9 to 11 P.M. 31st October from north-east.	11 P.M. 31st October to 2 A.M. 1st November from east, east inclined to south. At 1 A.M. there were three or four rushes direct from south.	4-30 to 5 A.M. 1st November	5 to 9 A.M. 1st November.	Water first came from south at 2 A.M. 1st November; then from west at 5 A.M.; from 6 A.M. began to subside.	9 A.M. 1st November	The velocity of the wind from the east was greater than that of the wind from the north-east. The force of the wind from the west appeared to be about the same as that from the east.
Siddhi ...	8 to 18 ...	9 P.M. 31st October to 2 A.M. 1st November north-east.	2 to 3-30 A.M. 1st November from east.	3-30 to 4 A.M. 1st November	4 to 9 A.M. 1st November.	Water first came from north-east at 2 A.M. 1st November, then from west at 4 A.M.; after half an hour began to subside.	Ditto ...	Time of flood-tide was 11 P.M. 31st October. Time of ebb-tide was 4 A.M. 1st November.
Sundeep ...	7 to 18 ...	11 P.M. 31st October to 2 A.M. 1st November from north-north-east.	2 to 2-30 A.M. 1st November from east, and then from 2-30 to 3-30 A.M. south-east.	Ditto ...	Ditto ...	Water first came from south-east at 2-30 A.M. 1st November, then from west at 4 A.M.	Ditto ...	In churs north of Hattiya and Sundip the water first came from the north-east: it was salt water.
Nulchira ...	9 to 28 ...	8 to 11 P.M. 31st October from north to east.	11 P.M. 31st October to 1 A.M. 1st November from east, then up to 3 A.M. from south-east.	3 to 3-30 A.M. 1st November	3-30 to 9 A.M. 1st November	Water first came from south-east at 2 A.M., then from west at 3-30 A.M.	Ditto.	
Hattiya ...	7 to 28 ...							
Nilakhyi ...	9 to 28 ...							
Sudharam ...	3½ feet on the very elevated parts, and 8 feet on the general low level land in the town, and 10 feet one mile south.	9 P.M. 31st October to 2 A.M. 1st November from north-east.	2 to 4 A.M. 1st November from east, and east inclined to south. At 3-30 there were three or four gusts from the south direct.	4 to 4-30 A.M. 1st November	4-30 to 6-30 A.M. from west, and then from north-west, afterwards from north.	Water first came from south at 5-30 A.M., and then from west at 6-30 A.M.; began to subside from 7 A.M.	Ditto.	

The vortex passed over the islands of Nulchira and Hattiya between 3 and 3-30 A.M., over Siddhi between 3-30 and 4 A.M., over Noakholly, according to the most reliable accounts, from 4 to 4-30 A.M., and, as will be presently stated, over Dewangunge about 5 A.M. This would give a rate of advance of from 20 to 25 miles per hour, and confirms the unusually high velocity which has been already derived from the positions of the vessels in and near its path over the upper portion of the Bay.

The following are abstracts of the reports of the meteorology of the districts at the mouth of the Megna, obtained and forwarded by Mr. Porch, Collector of the Noakholly district, and give the whole of the information which could be gathered from the native officials and population of the changes of wind direction over the area including the path of the cyclone vortex:—

Nulchira.—The wind during the day was from the north and north-east, increasing during the night. It afterwards changed to south-west and west, and blew very hard. The wind fell rapidly during the morning of the 1st.

North Hattiya.—The day of the 31st was cloudy, the wind blowing from the north-east. At noon there was a shower which lasted half an hour. At 3 P.M. it began to rain again, and continued until 8 A.M. of the following day. It was, however, not heavy, except before the commencement of the storm, which began about 8 P.M., the wind then blowing from the north and gradually increasing in intensity. It became very violent at 11 P.M., and then shifted to the east, still increasing in violence, and blew down trees and houses.

Sundeep.—During the afternoon of the 31st the wind was from the north, and gradually increased in velocity. At 11 P.M. it shifted to north-east, and at 11-30 P.M. to east. The wind was at that time so violent that trees were uprooted and houses blown down. At 12 P.M. it veered to south-east, and was still increasing in intensity and accompanied with rain. At 1 P.M. it veered through south to south-west, and continued to blow in that direction during the remainder of the night. The result of later enquiries is that no period of calm such as that described in the report of Baboo Sreenath Ghose occurred in the island of Sundeep during the cyclone.

Siddhi.—The sky was cloudy on the 31st, rain falling during the afternoon. The wind was then from the north and north-east, and blew hard from 11 P.M. It afterwards changed to east, still increasing in violence, and blew down houses and trees. At about 3 A.M. there was a short calm, after which the wind went round rapidly from south through south-west to west, from which direction it blew hard. There was rain during the night, but no thunder or lightning.

South Bamni.—The wind previous to 3 A.M. of the 1st had shifted from north through north-east to east. Shortly after 3 A.M. it changed to the west.

Noakholly.—The information of the state of the weather for this station is much more complete. The following is Mr. Porch's interesting account of the storm at this station.

"The storm at Noakholly appeared at about 11 P.M. as a cyclone, the north being its general direction, with a bearing to the east. It showed a tendency also to go southwards by the east, but blew only a very short time from the south-east at about 11-30 or 12 P.M. in the extreme south of the district. It attained its greatest force from the east at about 1 A.M. and maintained the same force, when it veered back to the north-east at about 1-15 A.M. This was the first part of the storm, during which the wind blew chiefly from the north-east; and towards its close, at about 3-30 A.M., the wind was described as variable and unsteady, and shifting about with violent gusts, east and west and east, from a northerly direction. People say at Noakholly strong gusts at about 3 A.M. came from the north-east, then north-west and west, and then a few strong gusts from the south-west and south, and again from north-east, which last direction the storm generally maintained, when the wind rather quickly fell at about 3-30 A.M. Then there was a lull from 4 A.M. to 4-30 A.M., towards the close of which the inundation was heard coming in along with the wind from the west; the wind, again increasing from the west, blew hard. This was the second part of the storm as experienced by people at the Noakholly station. In that interval of calm, the moon being bright, people left their broken-down houses and homesteads to look after their neighbours and to see the injury done to one-another's houses, and to learn how they had fared in the storm. Then began to be heard what the natives describe as horrible sounds, viz. distant roaring from the wind and inundation in the south, which afterwards appeared at Noakholly between 5-15 and 5-30 A.M., and which they could then hear, while there was perfect calm and stillness, amid the desolation at the station of Noakholly.

"The greater part of the trees lie from north to south with much westerly direction, and a great many lie due west, and some very slightly inclined to the north-west. Some houses and some trees were found lying to the east. It seemed to me that night that the wind from the west at about 4-30 A.M. was quite as swift and strong as the wind from the north-east before it reached the climax at 1 A.M. It was very strong, and it may, as some others assert, have been as strong at this place from the west in the second part of the storm as it was at any time from the east and north-east in the first part; but it was of short duration in intensity from west compared with its duration from the north and north-east and east in the first part of the storm. The second appearance of the cyclone, with its counter-blast from the west, has not left such marked signs of its direction in fallen trees and houses, &c., as the protracted and intense blowing of the first part of the cyclone from the north-east has left everywhere. The force of the cyclone was greatest from the east and north-east at 1 A.M., and after, as described, till the storm began to oscillate and was followed by a lull at about 4 A.M. The European residents and almost all the people in the station were up all night and were observing what was going on. The Civil Medical Officer's report (given below) appears to be very correct as regards Noakholly (Sudharam).

"The cyclone appeared and prevailed first north and north-east, generally showing much variableness from 3-30 to 4 A.M. just before the lull. After this it reappeared in an almost opposite quarter and considerably south apparently of its first area. It seemed to travel up, as it were, from the Bay to north, blowing across the islands obliquely from the west inclined to south-west towards the east, and this direction of the wind with the direction of the tide caused the great inundation from south-west to north-east. The Daula water inundation from the west after the lull was therefore experienced first in the islands on the extreme south, and then gradually in the north of the islands and over the mainland during the next two hours, as the westerly wind travelled northwards. The lull too appears to have been earlier and of much shorter duration in the islands to the south.

"The Sundeep and Hattya people say that for two or three days before the cyclone they constantly heard a roaring sound to the south in the Bay, and they knew that it was a traditional warning of a storm and flood, but in their easy-going heedlessness they almost all took no precautions. A very few people, however, in both islands, thus forewarned, are said to have prepared plantain-rafts and tied them with long ropes to the trees in their home plantations, and thus saved themselves and their families. The inhabitants of these parts know their danger in the months of Jyest and Kartick, and should always have such simple life-buoys of plantain trees or plantain and bamboo and rope ready fixed adjoining their houses within their tree-surrounded compounds. Many people in the islands and on the mainland say they saw lights passing apparently from west to east at the beginning of the cyclone. The Amergong people saw lights keep on appearing at several points on the horizon in the east. In thanas Sudharam and Begumgunge hailstones fell at the beginning of the cyclone. At Begumgunge a light was seen in the east like a comet, the people say."

The following account sent by Mr. Lyons, Civil Medical Officer, gives the observed changes of wind direction and the chief features of the storm at Noakholly:—

4 to 5 P.M.—Heavy shower; wind N.N.E.

7 to 8 P.M.—Drizzling rain; wind N.N.E., cold and sharp.

9 P.M.—Drizzling rain; wind freshening, N.N.E.

10 P.M.—Rain heavier; wind last half-hour blowing strong from N.N.E.

11 P.M.—Heavy rain; wind blowing a hurricane from N.N.E.

12 P.M.—Heavy rain, but it looks like mist as it is borne along the wind; wind blowing a hurricane from N.N.E.

1 A.M.—Heavy rain, but it looks like mist as it is borne along the wind; wind, if anything, higher, and a few minutes past this hour it suddenly changed to east for about a quarter of an hour, returning as suddenly to N.N.E., when I noticed the falling of a tree some fifty yards north of the circuit-house. The storm evidently was now at its height, as tree after tree came down and the window-shutters on the north face of the circuit-house were torn away.

2 A.M.—Still raining heavily; wind blowing furiously from N.N.E.

3 A.M.—Rain abating; wind still high from N.N.E., but not blowing so furiously.

3-30 A.M.—Rain ceased and there is a perfect lull. What little wind there is, is from the west, and borne on it is a distant soughing sound, which gradually, as the wind again rising high at 4 A.M., deepens with a "booming," now recognized as the sound of rushing water, which about 5 A.M. reached the station. Shortly after this hour the wind died away to a cold sharp breeze, the flood advancing meanwhile and reaching its maximum height some (3½ feet in the more elevated parts of the station) about 7 A.M.

The rainfall registered in the jail was 5·12 inches.

Note by R. PORCH, ESQ., *Officiating Magistrate, Noakholly.*

Noakholly.—The wind blew with great force from N.N.E. from 11 P.M., and blew with its full force when it veered to the east at about 1 A.M. Then the destruction went on, and after, when it veered back to N.E., maintaining its highest force and velocity, and continued blowing furiously.

his report he says,—"Towards the close of the first part of the storm, at about 3-30 A.M., the wind was described as variable and unsteady, and shifting about with violent gusts east and west, and east from a northern direction (*i.e.* through north). People say at Noakholly strong gusts came from the north-east, then north-west and west, and then a few strong gusts from the south-west and west, and again from north-east, which last direction the storm generally maintained, when the wind rather quickly fell at 3-30 A.M. Then there was a lull from 4 A.M. to 4-30 A.M., after which the wind, again increasing, blew hard from the west." Mr. Porch's facts attesting the variableness of the wind are confirmed by the report of Annoda Kishore Roy, Court Inspector at Noakholly:—

31st October, evening.—Wind due north.

10 to 11-30 P.M.—North with violence.

12 to 2 A.M. and 2 to 3 A.M.—Wind north-east and east, at the end of which time there were gusts from west and north-west, veering towards south-west at the close. The wind was, however, generally in the north-east.

3-30 to 4 A.M.—Lull.

4 to 5-30 A.M.—Wind westerly.

8-30 in the morning.—Wind north and north-east.

The length of the lull was about half an hour. It was general throughout the district.

The Court Inspector states clearly that at 3 A.M. there were gusts of wind from west and north-west, and that it veered towards the south-west, but that the wind was generally in the north-east before the lull from 3-30 to 4 A.M.

Probable instances of the formation of a new vortex in advance are given in the report on the Calcutta cyclone of 1864.

A strange fact, brought to my notice by Mr. Porch as having given rise to much superstitious feeling amongst the natives, is that the great mandar-tree on chur Sekundur, on the coast to the south of Noakholly, a well-known land mark, has escaped injury, without, as the natives say, the loss of a branch or leaf to mark the completeness of its escape amidst the surrounding desolation.

Amergaon.—The wind blew from north during the 31st, increasing in velocity as evening set in. Rain began to fall about 2 P.M. At nightfall the wind still continued to increase, and at 11 P.M. changed its direction from north to north-east, and then veered to east and south-east about midnight. There was a short calm at about 3 A.M., when the wind veered to the west. There was a calm every time the wind changed its direction, but these calms were hardly perceptible, whilst the calm, which lasted about half an hour, when the wind changed from south-east to due west, was altogether different.

Amergaon is north-east from Noakholly, at a distance of 18 miles. The eastern edge of the vortex passed over it, as indicated by the calm and change of wind. The time (3 A.M.) is evidently wrong, depending only upon the information of the villagers.

Dewangunge.—The sky was cloudy and gloomy during the whole day. At 3 P.M. rain began to fall in slight showers; it fell more heavily as night approached. The wind increased during the evening, and was blowing very strongly from the north-east at 11 P.M. It then shifted through east to south, blowing with redoubled force, and overturning whatever opposed it. It afterwards went round rapidly to west, gradually abating, though rain continued to fall until 11 A.M. of the 1st. "Another informant states that the storm ceased for a short time at 5 A.M., the calm lasting about 10 or 12 minutes. The sky at the time appeared red in the west."

Silonea.—There was a calm of about five minutes at 5 A.M., the only interval of prolonged calm which was observed at this station.

Lakhipoor, 19 *miles to west-north-west of Noakholly.*—The weather was cloudy on the evening of the 31st, the wind being from the north-east. It was not so dark as is usually the case before the occurrence of a storm. It began to blow heavily at midnight from the north, then from the east, and afterwards from the west. There was no thunder or lightning, only horrible sounds were heard. The wind continued until 8 A.M. of the 1st. During its continuance there were occasional lulls lasting for two or three minutes.

Mirserai.—An easterly wind began to blow strongly at 9 P.M., and was attended with drizzling rain. It afterwards shifted to south-east, growing more violent until 3 A.M. From 4 A.M. to 7 A.M. it blew from the south-west with equal violence.

The reports from the remaining stations and villages near the storm centre from which I have received information are very meagre and unsatisfactory, judged from a meteorological standpoint.

Little more remains to be told of the path of the vortex of the Backergunge cyclone. After passing north-east over Noakholly at 4 A.M. and over Dewangunge and Silonea at 5 A.M., where the interval of calm was comparatively short, it was advancing towards the angle formed by the Tipperah Hills and the Arrakan Hills. The whole of the district is thinly populated. It is a tract gradually rising up from the flat land along the banks of the Megna. The Tipperah Hills are not very high, but they consist of a series of parallel ridges running north and south, increasing in height eastwards. The outlying spurs near the sea are not more than three or four hundred feet high, but the more central portions attain at their highest points an elevation of from two to four thousand feet. The cyclone disturbance occupied an area of at least 400 miles in diameter at sea. When the centre was passing over Noakholly the northern limits had been involved for some time amongst the Tipperah Hills. The disturbing action of these ridges, which were at right angles to the direction of motion of the wind in the northern quadrant of the cyclone, was rapidly shown. The large regular converging motion towards the centre was prevented on the north-eastern side, and a number of small eddies probably formed. The result was that the vortex broke up at some distance south of the Tipperah Hills, two or three hours after it passed over the north-east angle of the Bay.

Comillah.—The Civil Surgeon of Comillah, a station 45 miles due north from Noakholly, writes that the wind for several days previous to the 31st had been steady from the north. The barometer fell on the 31st, whilst the wind changed to north-east. No readings of the barometer were taken, as the building containing it was unroofed during the storm. The anemometer was also blown away during the evening. The wind during the afternoon and evening blew strongly from the north, with occasional gusts, and shifted a little towards the east from 9 P.M. until 11-30 P.M., when the storm increased to a hurricane, the wind coming from the north-east, with occasional lulls. It continued to blow a strong gale from the same quarter until 5 A.M. of the 1st, when it gradually moderated, and was fine weather at 7-30 A.M.

The steadiness of the wind direction at Comillah and the cessation of the storm three hours after its centre passed over Noakholly are important. The wind direction indicates that the station was on the north-western quadrant of the cyclone when its vortex was passing over the mouth of the Megna. There was thus at Comillah a steady north-east wind, very violent from 11-30 P.M. to 4 A.M., during which the distance of the vortex had decreased from 130 to 45 miles. During the next two hours the centre did not advance so far north as to affect the wind direction. The only possible inference is that the vortex which passed over Noakholly advanced a very short distance to the north-east, and was broken up at least 20 or 30 miles south-east of Comillah. The Backergunge cyclone was on a much larger scale than the Vizagapatam cyclone. Its central area of calm was much larger, and the diameter of the air moving with hurricane force was probably five or six times as great. Its rate of progression was more than double of that of the Vizagapatam cyclone. Both advanced almost directly to the opposing mountain masses, and yet from slight differences in the character of the mountain obstructions, the smaller and slower—moving cyclone merely suffered deflection and slow disintegration, whilst the larger and more rapid cyclone was not only completely broken up in the space of a few hours, but its extinction was very speedily followed by the disappearance of the atmospheric disturbance, of which the cyclone was one feature.

Agurtolla.—Agurtolla is 30 miles due north of Comillah, on the western extremity of the Tipperah Hills. Here nothing more than a stiff gale was experienced. The sky was cloudy on the 30th and 31st, and a slight rainfall occurred on the latter day. The wind during the advance of the cyclone varied from north-east to north, and was not so violent as to do any considerable injury to houses or trees. Mr. Bradbury, Magistrate at Agurtolla, writes :—"The wind here shifted very little, and blew from the north and north-west during the night and the following morning until the storm subsided. There were no gusts from the east or south or west. The storm was most violent about 4 or 4-30 A.M., and then gradually lulled, ceasing entirely about 11 A.M. It was much less furious here than at Comillah ; at Agurtolla not more than 20 or 30 huts were blown down, and no lives were lost. Throughout Hill Tipperah the only serious damage done was to the crops, which being in ear, suffered to the extent of from one-eighth to one-fourth."

Adamtila.—Captain Nuthall, R.N., a tea planter residing at Adamtila, about 30 miles north of Agurtolla, and amongst the northern spurs of the Tipperah Hills, states that there was a very heavy gale of wind there on the morning of the 1st. It commenced about 2 A.M., the barometer falling rapidly until 7 A.M. 1·32 inches of rain fell on the 1st. Although the wind was very violent, it did no injury beyond breaking down some plantain trees.

Sylhet.—At Sylhet, 35 miles north-west of Adamtila, there is a Government observatory, but the observer took no special observations, as the wind was not very violent there. The ordinary observations show that the 31st was cloudy, and that slight rainfall occurred at intervals. At 11 P.M. the wind was blowing from the east, and it gradually shifted to the north, from which quarter it was blowing when the gale was at its height at 4 A.M. The wind gradually abated as day came on, when it is said to have come from a little west of north. The storm was over by 10 A.M. The total rainfall was 1·24 inches. The amount of wind registered by the anemometer from 4 P.M. of the 31st to 10 A.M. of the 1st was 390 miles.

Cachar.—The Superintendent of the Cachar observatory, 60 miles to the east of Sylhet, and about 80 miles to the north of the angle formed by the Tipperah and Arakan Hills, states that the storm there was not severe. It began to blow from the north-east at 2-30 A.M. and continued until 10-30 A.M., during which interval 1·3 inches of rain fell. No damage was done in the station, a few old houses, however, being said to have been blown down in the district.

The above evidence is conclusive that the storm vortex not only did not reach the Tipperah Hills, but that it was broken up at a considerable distance south, and that the minor eddies which were formed by the obstructive and disintegrating action of the hills, although they continued for five or six hours after the arrival of the vortex at the mouth of the Megna, rapidly died away, and that at midday of the 1st the cyclone was practically extinguished, the only after effects on the weather being a slight rainfall during the next 48 hours in Assam and the neighbouring hills.

The following account of the cyclone at Burrisal, sent to me by the Civil Medical Officer, is the chief information I have received from the Backergunge district:—

"The weather had been cloudy for the last few days. On the 30th and 31st October slight rain occurred at intervals. On the morning of 31st October the wind blew from S.E. During the afternoon it changed to N.E. Towards evening it came from a direction nearer north and increased in strength. During the night it increased to a hurricane, prostrating trees and breaking large limbs and foliage from them. Most of these trees lie in a direction from a little to west of north. Towards morning, at about 4 A.M., the wind decreased in violence and changed to a direction from near west. Its period of greatest violence was from midnight to 4 A.M. Over 90 per cent. of the kutcha houses composing the bazar have been thrown down. In order to show the great force of the wind, I may mention that the largest portions of the north and south walls of the racquet court have been blown down in mass. This building did not suffer in the cyclone of 1867. Slight rain accompanied, but there was no thunder or lightning. An aneroid barometer on the evening of 31st October stood at 30·200. From this time it steadily fell to 4 A.M., when it stood at 29·280. The rainfall on the 31st was ·36 inches and on the 30th ·01 inches. No change occurred in the relative humidity of the air."

The following table gives briefly the information sent to me by the various district officers, and whilst it confirms the path as charted from the facts given in the previous paragraphs, it is useful as supplying information defining the limits of the area affected by the cyclone. The cyclonic area extended from Saugor Island to the island of Katoobdia and the small station of Cox's Bazar. As it advanced inland it rapidly contracted, and included the whole of the Backergunge, Noakholly, and Chittagong districts, the Tipperah Hill division, and the eastern portions of the Jessore, Dacca, and Mymensingh districts.

DISTRICTS.	STATIONS.	31ST OCTOBER 1876.			1ST NOVEMBER 1876.				REMARKS.
		Before 10 P.M.	10 P.M.	12 P.M.	2 A.M.	3 A.M.	4 A.M.	After 4 A.M.	
Jessore.	Bagirhaut ...	Cloudy ... Raining, 4 P.M. Wind N.E.	N.E.	N.	......	......	N.W.	W.	Total rainfall 2·78 inches. Many houses blown down and dispensary building much damaged.
	Khoolna	Frequent showers	N.E.	N.	N.	N.	......	......	
	Nurrail	Strong wind ... Gloomy sky. Rain.	N.E.	N.	N.	N.	......	......	
	Jhenidah ...	10 A.M., 29·8 ... 4 P.M., 29·69 ... Gloomy; occasional rain; wind N.E.	29·63 Strong gusts N.E.	Bar. 29·51 Wind N.E. Strong gusts with light rain.	Bar. 29·47 Wind shifting to N.; blowing in puffs at intervals.	Bar. 29·48 Wind N., moderating; rain ceased.	......	6 A.M., 29·63; wind N.W., sky clearing.	Fine day on the 1st, light N.W. wind; barometer rising rapidly.
	Jessore	Bar. reduced to 32° 10 A.M., 29·783 ... 4 P.M., 29·663 ... Wind N.E. ...	Bar. 29·610 Wind N.E. 109·2 miles registered from 4 P.M. by anemometer.	......	......	......	Bar. 29·410; wind E.	10 A.M., 29·733; wind W.	Rainfall 1·05″ during storm. The wind during the storm first blew from E. and veered round N. to W., from which it was blowing when the storm subsided.
Nuddea.	Nuddea	Heavy clouds from early morning. 10 A.M., 29·72. 4 P.M., 29·72. Wind N.E. Rain slightly.	Wind blowing fresh from N.N.E.	......	......	Wind increased during night.	......	10 A.M., 29·65; wind W.N.W.; heavy clouds. 4 P.M., 29·63; wind N.W. with sky clear.	Rainfall 0·8 inches.
	Krishnaghur ...	Day very cloudy and windy.	Wind N. to N.E.	......	......	......	......	......	Rainfall 0·7 inches.
	Chooadanga ...	Sky very cloudy...	......	......	......	......	......	......	Wind from N.E. during the night.
	Bongong	Cloudy and rain during the day.	E.	N.E.	N.	......	......	......	
	Kishengunge ...	28th to 31st sky cloudy; wind in gusts from N.E., with rain.	9 P.M. "Strong close reefed topsail breeze" with rain; wind N.E.	......	Wind began to abate.				
	Jellinghy River Toll Office.	Wind N.E. ...	......	N.E.	N.E.	N.E.	N.E.	6 A.M., wind veered to N.W. and W.	Sky cleared up at midday.
Dacca.	Dacca	Bar. reduced to 32° 10 A.M. 29·806 ... Wind N.N.E. ... 4 P.M. 29·701 ... Wind N.	Bar. 29·643 ...... N.E.	12-50 A. M. 29·490. N.N.E.	Bar. 29·380 N.E.	...... N.E.	......	10 A.M., 29·678; W.N.W.	Total rain during storm 1·92 inches.
Fureedpore.	Madaripore ...	7 P.M. to 10 P.M. N.	N.E.	......	......	......	......	......	About 6·30 A.M. the river began to rise rapidly, viz. 5 feet in three quarters of an hour.
Mymensingh.	Mymensingh ...	Cloudy day ...	N.E.	N.E.	N.E.	......	......	......	Storm lasted until 6 A.M; rainfall 0·26; wind gusty, but never high, and did no damage.
	Kishoregunge ...	....	......	......	......	......	......	......	Rainfall 0·92; many huts were blown down and a boat capsized on the Megna.
	Attia	S.E. before gale ...	......	......	......	N.E.	......	N.	Rainfall 0·08; no gale or destruction of property.
Pubna.	Pubna	Cloudy day, ·19 inches of rain up to 6 P.M.	......	Wind blew hard and "almost a gale"	Direction of wind N. to N.E.	......	Wind began to abate.	......	Total rainfall 0·2 inches from 6 P.M. of 31st.
	Serajgunge ...	Afternoon cloudy with slight rain. Wind N.E.	N.E.	N.	......	......	......	......	7 (?) inches of rain fell during the night. Morning of 1st was fine with a light wind.
Bogra.	Bogra	No rainfall ...	......	Wind blew during night from E. by N., but with no excessive violence.					No rainfall.
	Shiraghur	....	......	......	......	......	......	......	0·15 inches of rainfall.
Rungpore.	Nowkhila	....	Wind stated to have come from S.E. in gusts and to have shifted to N.E. on following morning (?)						0·3 inches rain.
	Rungpore	Sky cloudy, wind N.E.	N.E.	N.E.	N.E.	N.	N.	10 A.M., wind strong from N.W.	On the 31st, when sky was dark, the snowy range was very clearly visible.
Chittagong Hill Tracts.	Rungamattee ...	Cloudy during day	......	......	......	......	......	......	Was blowing from E. at 2 A.M. and shifted through S.E. and S. to S.W. The wind was very violent from the S.W.
	Demagiree... ...	....	......	......	......	......	......	......	Wind commenced to blow from the E. No damage was done to houses or huts.
	Ruma	....	......	......	......	......	......	......	Began at 10-30 P.M., and lasted till 6 A.M; wind S.E.

The chief feature of the storm in its passage over Eastern Bengal was the absence of heavy rainfall. There was slight rainfall over the whole of this portion of Bengal and the adjacent districts to the east on the 31st, followed by heavier rainfall during the storm on the morning of the 1st. The following gives the amount of rainfall registered on the 31st and 1st at the more important stations in the cyclone area :—

(1)—*Stations on eastern quadrant of cyclone.*

	31st October.	1st November.
Cox's Bazar	0·06	3·15
Chittagong	0·10	2·50
Fenny	0·11	3·20
Rungamuttee	...	2·00

(2)—*Station in path of storm vortex.*

	31st October.	1st November.
Noakholly	0·26	5·12

(3)—*Stations on western quadrant of cyclone.*

	31st October.	1st November.
Hill Tipperah	0·05	1·92
Comillah	...	3·55
Brahmunberiah	0·06	1·51
Burrisal	0·36	3·04
Perozepore	0·60	1·81
Putuakhally	0·90	5·85
Bagirhat	...	2·78
Dacca	0·14	...
Furreedpore	0·89	...
Goalundo	0·17	0·52
Khoolna	1·03	...
Jhenidah	0·89	...

Another feature was the almost entire absence of thunder and lightning during the storm on land.

The following observations were taken on board the S. S. *Prince Alfred*, which left Goalundo for Dacca on the 31st ultimo, and passed the night in the Budderchur khal, abreast of the Hilsamaree, through which the steamers go from the Pudma to the Megna :—

	Hour.	Wind.	Barometer.	Remarks.
October 31st	5-30 A.M.	N. E.	......	Weather looking doubtful.
	9 "	N. E.	26·86	
	12 "	N. E.	·84	Dull and dirty appearance all round.
	2 P.M.	N. E.	......	Weather looking worse. (Ran into Budderchur khal.)
	4 "	N. E.	·76	Squally from E.N.E.
	6 "	N. E.	·74	Increasing breeze and heavy rain. (Ordered fires to be banked).
	7-30 "	......	......	
	8 "	N. E.	·72	
	10 "	N. E.	·69	Moderate gale.
	10-30 "	N. E.	·67	
	11 "	N. E.	·65	Fresh gale.
	11-30 "	N. E.	·50	
	12 "	N. E.	·49	Strong gale.
November 1st	1 A.M.	N. E.	·45	Strong gusts.
	1-30 "	N. E.	·40	Ditto.
	2 "	N. E.	·39	Heavy gale with violent gusts and constant rain.
	2-30 "	N. E.	·38	
	3 "	N. E.	·35	Ditto ditto. (Engines at work 5 to 8 revolutions a minute.)
	3-30 "	N. E.	·34	
	4 "	N.	·34	Heavy gale with passing squalls of wind and rain.
	5 "	N.	·37	More moderate.
	6 "	N. W.	·40	Strong breeze with gloomy weather and rain.
	7 "	N. W.	·45	
	8 "	N. W.	·50	
	9 "	N. W.	·53	
	10 "	N. W.	·60	Weather clearing up.

The following observations were taken at Chittagong, Calcutta, and Saugor Island during the cyclone:—

Date and hour.	Barometer.			Wind Direction.			Wind Velocity.		
	Chittagong.	Calcutta.	Saugor Island.	Chittagong.	Calcutta.	Saugor Island.	Chittagong.	Calcutta.	Saugor Island.
October 31st.									
4 A.M. ...	......	......	29·714	......	......	N. E.	......	7	69·6
6-40 „ ...	......	......	·700	......	......	N. N. E. to N. E.	......	......	... ..
7 „ ...	......	......	·718	......	......	N. E.	......	40	47·9
8-20 „ ...	......	......	·745	......	......	N. N. E. to N. E.	......	......	......
9 „ ...	......	......	·726	......	......	N. N. E. to N. E.	......	25	31·2
10 „ ...	......	......	·721	......	......	N. N. E.	......	16	19·3
12-15 „ ...	......	......	·647	......	......	N. N. E.	......	......	40·5
1 P.M. ...	......	29·684	......	......	N. E.	......	.. ...	52	......
2 „ ...	......	·649	·576	......	N. E.	N. E.	......	15	38·5
3 „ ...	......	·653	·553	......	N. E.	N. E.	......	18	23·8
4 „ ...	......	·624	·521	......	N. E.	N. N. E.	......	20	23·4
5 „ ...	......	·632	......	......	N. E.	......	......	19	......
5-20 „ ...	......	......	·508	......	......	N. N. E.	......	......	39·3
6 „ ...	......	·618	·485	......	N. E.	N. N. E.	......	16	25·2
7 „ ...	......	·614	·477	......	N. E.	N. N. E.	......	25	34·9
8 „ ...	......	·580	·475	......	N. E.	N. N. W. to N. N. E.	......	24	36·0
9 „ ...	......	·558	·487	......	N. N. E.	N. W. by N. to N. N. E.	......	21	48·5
10 „ ...	......	·570	·496	......	N. by E.	N. W. to N. by W.	......	19	49·5
11 „ ...	......	·561	·523	......	N. N. E.	N. W. to N.	......	16	28·1
12 „ ...	......	·528	·518	......	N. by E.	N. W. to N.	......	30	25·8
November 1st.									
0-45 A.M. ...	29·283	......	......	E. N. E.	......	......	......	......	......
1 „ ...	......	·514	·545	......	N.	N. W.	......	30	23·8
1-15 „ ...	·205	......	......	N. E.	......	......	......	......	......
1-30 „ ...	·196	......	......	E. N. E.	......	......	......	......	......
1-45 „ ...	·186	......	......	E.	......	......	......	......	......
2 „ ...	·191	·523	·578	S. E.	N. N. W.	N. W.	......	25	21·8
2-15 „ ...	·166	......	......	S. S. E.	......	......	......	......	......
2-30 „ ...	·182	......	......	S. E.	......	......	......	......	......
2-45 „ ...	·102	......	......	E. S. E.	......	......	74·9	......	......
3 „ ...	·081	·553	·606	S. E.	N. N. W.	N. W.	......	19	20·4
3-10 „ ...	·081	......	......	S. S. E.	......	......	......	......	......
3-20 „ ...	·062	......	......	S. S. E.	......	......	......	......	......
3-30 „ ...	·058	......	......	S. S. E.	......	......	......	......	......
4 „ ...	·062	·596	·645	S.	N. N. W.	N. W.	......	12	17·0
4-30 „ ...	·124	......	......	S. S. W.	......	......	......	......	......

Date and hour.			Barometer.			Wind Direction.			Wind Velocity.		
			Chittagong.	Calcutta.	Saugor Island.	Chittagong.	Calcutta.	Saugor Island.	Chittagong.	Calcutta.	Saugor Island.
November 1st.											
5	A.M.	...	29·165	29·640	......	S. W.	W. N. W.	......	......	11	......
5-10	„	...	·184	......	......	W.	......	......	......	......	......
5-20	„	...	·216	......	......	W.	......	......	......	......	......
5-35	„	...	·266	......	......	W.	......	......	......	......	......
5-50	„	...	·358	......	......	......	......	......	210·6	......	......
6	„	...	·441	·682	......	......	W. N. W.	......	......	13	......
6-10	„	...	·487	......	......	......	......	......	17·1	......	......
6-20	„	...	·537	......	......	......	......	......	......	......	......
6-30	„	...	·590	......	......	......	......	......	19·5	......	......
7		...	·650	·712	......	......	W. N. W.	......	29·3	16	......
8	„	...	·670	·748	......	......	W. N. W.	......	28·3	18	......
9	„	...	·696	·781	......	......	W. N. W.	......	18·2	10	......
10	„	...	......	·790	......	......	W.	......	......	13	......

The Telegraph Master at Chittagong, Mr. Burke, who is also the meteorological observer, gives the following account of the storm and of the difficulties which he experienced in taking the observations:—

On the evening of the 31st, at 16 hours, the direction of the wind had been N. E., but at about 9 P.M. it had veered round to N. W., and again when the first observation was taken it had gone round to E. N. E. At 9 P.M. the wind was not high, but would be called a pleasant breeze.

At 0-30 hours I was required in office, owing to failure of telegraphic communication with Akyab. The wind at this time was very high and from a north-easterly direction. An observation was made of the barometer at 0-45 hours and the readings obtained reported by telegraph, immediately after which there was a total interruption to communication on both sides, and the further observations made could not be wired. It was also raining very heavily, and the rain carried by the high wind had wet all the instruments in the meteorological shed, so much so that water was running out at the bottom of the cage.

I endeavoured to obtain readings of the dry and wet bulb thermometers, but owing to the fine spray caused by the dashing of the rain against the instruments and the motion of the water running down the tubes, I was unable to obtain one in the short time that the lantern could be kept lighted. But the reading of the dry and wet bulb thermometers could not have differed, as they were equally wet.

The same difficulty attended the reading of the anemometer, which, from its position on the roof of the building, was exposed to the full force of the storm and driving rain. After a number of unsuccessful attempts, owing to the lantern being blown out, and the difficulty of retaining my position at the edge of the parapet, a reading was obtained.

At 1-45 hours the force of the wind had increased so much that the meteorological shed was in danger of being blown down; the instruments were therefore removed and brought into the office.

At 2-45 hours another reading of the anemometer was made, but the force of the wind was so great as to prevent anything like accuracy in this observation. It was with great difficulty that I retained my position on the roof of the building, nor could the lantern be kept lighted more than a second or two when held up to throw light on the wheel-work.

At 3-30 hours the masonry wall of the office, a pucca building, began to be shaken, the plaster falling off all parts. To save them from destruction, the clock and telegraph instruments were removed. I was about to remove the barometer also, the wall above it showing signs of bulging in, when a piece of plaster about ten square feet fell in, leaving the barometer uninjured. The position of the instrument then appearing to be safe, it was allowed to remain, and the observations continued at ten minute intervals, as well as I could guess, there being nothing to show the time. At 6 hours I got time again and continued the observations regularly till the barometer rose again to its normal height.

At 5-45 hours I observed that the feather of the arrow of the wind vane had been wrenched off. The exact time that this happened I am unable to state with certainty, but it appears to have been just about this time, for the index, which before that had been pointing to 24, suddenly swung round from 24 to 8, or just a half circle.

The barometric observations in the table are corrected for temperature. The height of the cistern of the barometer above mean sea-level at Saugor Island is 6 feet, at Calcutta 18·1 feet, and at Chittagong 90 feet.

The lowest observed reading of the barometer at Saugor Island was 29·475 at 8 P.M., when the storm centre was at a distance of 150 miles to the E. S. E. The lowest observed reading at Calcutta was 29·514 at 1 A.M. Calcutta was at the same distance from the storm centre as Saugor Island. The difference of the lowest readings (reduced to sea level) is ·051. The total fall at either station was not very great: the fall at Saugor Island from 8-20 A.M. to 8 P.M. was ·239 inches, and at Calcutta from 1 P.M. of the 31st to 1 A.M. of the 1st ·170 inches. Thus, even before its arrival at the mouth of the Megna, the land action on its outer limits was slowly diminishing the strength of the cyclone, whether measured by the total barometric fall or the rate of fall before the nearest approach of the storm centre. Chittagong was 35 miles from the storm centre at 3-30 A.M., when it was passing over the islands of Hattiya and Siddhi. The lowest reading of the barometer reduced to sea level was 29·148 at 3-30 A.M.; it fell from 29·373 at 0-45 A.M. to 29·152 at 3-20 A.M., or ·221 inches in two hours and a half. It continued at nearly the same height for forty minutes, or until 4 A.M., after which it increased very rapidly. The reading at 6-30 A.M. was 29·680 inches, giving a rise of ·528 inches in two and a half hours after the time of nearest approach of the storm centre. The barometer thus rose between two and three times as quickly as it had fallen—an additional proof of the fact that has been already stated, the rapidity with which the storm was broken up after 4 A.M., and also showing, as I believe, that a considerable part of the diminution of pressure during the cyclone is due to the actual motion of the air. The wind velocities recorded in the table give the actual motion of the air indicated by the anemometers between the time for which the velocity is given and the preceding observations.

The wind velocity at Saugor Island was highest between 8 P.M. and 10 P.M., or immediately after the lowest reading of the barometer. The average wind velocity at Chittagong between 2-45 and 5-45 A.M. was upwards of 70 miles per hour. From 6 A.M to 7 A.M. the mean velocity was 58 miles per hour, and after this it decreased very rapidly. The amount registered between 7 A.M. and 8 A.M. was 28·3 miles, and between 8 A.M. to 9 A.M. was only 15·2 miles.

CHAPTER V.

The Storm-Wave.

THE cyclone whose origin and path have been discussed in the preceding pages will long be remembered for the unprecedented loss of life, due to the flood of waters poured over the islands at the mouth of the Megna by the storm-wave which accompanied it.

The accumulation of water at and near the centre of a cyclone is produced by a combination of causes, the most powerful of which in this case was probably the diminished air pressure. This alone would account for a rise of from one to two feet over an area upwards of 400 miles in diameter. The vorticose motion of the atmosphere in cyclones also undoubtedly tends to give a similar movement to the water over which it is circulating. The logs of the *Allahabad*, *Lightning*, and other vessels show that during the cyclone there were strong north-east and south-west sea currents on opposite quadrants of the cyclone, the former of which, near the head of the Bay, was probably the stronger of the two for evident reasons. This motion, vorticose in its character, would necessarily tend to pile up the water in the central area of calm. The head due to the two causes might amount to three or four feet. This mass of water advanced with the storm, and the energy stored up in it as potential energy represented a considerable amount of the mechanical energy due, as a secondary effect, to the enormous heat given out in the process of condensation over the area of rainfall in the Bay. In the case of the Backergunge cyclone, this piled-up mass of water advanced under the pressure of the acting forces towards the head of the Bay as a storm-wave at the rate of at least twenty miles per hour, and reached the shallows near the entrance of the estuary of the Megna without any change of form or character. The friction from the shallow bed then began to act rapidly and retarded its progress. The storm-wave, under the action of this suddenly encountered and increasing resistance, rapidly accumulated over the shallows near the mouth of the river. It was also over the same area and to the north, opposed by the fresh waters of the river seeking for an oceanic outlet, and tending to advance southward under the pressure of the continuously accumulating mass brought down more rapidly than usual by the action of the northerly winds in Bengal and easterly winds in Assam. These two vast and accumulating masses of water opposed each other over the shallows of the estuary. During the struggle and contention for mastery there would be for some time a very considerable piling up of the waters immediately to the south of the islands, the land-marks of the shallows stretching to some distance southwards. This accumulation would be followed by the inrush of the larger and more powerful mass of waters forming the storm-wave, driving back the river water and advancing first in the form of a wave, carrying all before it. The character and extent of the inundation in such a case depend upon a variety of causes, and would present very different features at different parts of the estuary. The magnitude of the storm-wave, the size of the river, the wind direction and changes of direction, and the relation in time of the storm-wave to the ordinary tidal wave, must all be taken into consideration.

Before tracing more fully the progress of the storm-wave of the morning of the 1st November, it will be desirable to describe briefly the character of the district near the mouth of the united Ganges and Brahmaputra, and the nature of the tidal action in the north-eastern angle of the Bay of Bengal.

The Brahmaputra, one of the largest and least known of the rivers of India, rises in the plateau of Thibet, and drains the northern flank of the Himalayas eastward of lake Mansarawar: it brings down at all times a vast quantity of water: its volume has been computed at Goalpara at its lowest ebb to be 146,000 cubic feet per second, representing a mass of water covering 20 square miles to the depth of one foot per hour. The Ganges brings down an almost equal volume of water, and unites with the Brahmaputra opposite Goalpara. They are joined by the Megna, and the three united streams, known locally as the Megna, after a course of 100 miles, expand into a noble estuary, studded with large islands, which form three lines, stretching north and south, between which and the mainland the river finds its way to the sea. The most westerly of these three lines of islands is formed by the islands of Badura and Dukhin Shahbazpore, separated from the mainland of Backergunge by the Tetoolia river. In the centre are the islands of Nalchira and Hattiya, separated from Dukhin Shahbazpore by the Shahbazpore river, and from the third and most easterly line of islands, consisting of Sundip and Siddhi, by the Megna and the Hattiya rivers. The Sundip channel lies between the mainland of the Chittagong district and the third line of islands. The Shahbazpore and Megna rivers are the chief exits for the fresh water brought down by the united streams. The Sundip channel, on the other hand, plays the part of a waste-water reservoir or side channel, and its waters are always more or less brackish. The surface rises and falls with the tide, but the amount of fresh water brought down by it is always small.

The islands at the mouth of the Megna are all extremely low, and are merely the crests of an extensive and increasing alluvial deposit at the mouth of the estuary. They are formed chiefly from the *detritus* of the Himalayas deposited over the area in which the tidal and the river waters wage incessant warfare, alternately displacing each other.

The following account, taken from a paper given in the *Statistical Reporter* for May 1876, describes the growth and colonization of these island accretions at the mouth of the Megna :—

> "The fluvial and tidal action by which the district of Noakholly has been formed is still at work. New churs and islands appear—Degi churs as they are called—land which is under water at high tide and is visible during the ebb. These island formations gradually emerge from the water, and as soon as they cease to be overflowed by the tide, an engagement for the land at a nominal rent is entered into as a venture. When the grass and bush spring up, wild men, speaking a barbarous *patois*, come down to pasture large herds of cattle on the young herbage, putting up sheds for the beasts, they themselves bivouacking in the open. The person who has made his venture on the land now compels the cattle-owners to pay a grazing rent at so much a head a year for their cattle, and a rent for cutting fuel is taken. In course of time, as the land becomes fit for the plough, the person settling for the land will get a man of energy, if not of substance, to take charge of the cultivation of as much land as possible, and will give him a lease for a number of years. This man, the pioneer of cultivation, and afterwards often a leader of a colony of resident cultivators, will induce non-resident ryots from the neighbouring districts to plough and sow the lands, and the crops will be watched and harvested from temporary huts, and the grain carted away to their permanent holdings. As time progresses and the land improves, and the cultivation is permanently extended, ryots are induced to settle on the land and become residents. They dig large tanks for fresh-water supply and raise high mounds for foundations for their homesteads in the low country (which is intersected by numerous water-courses), and plant them round with betel, cocoanut, and date palms, plantains, mandar and other trees. Thus they settle with their families, and in a generation or two the new formation has become like the rest of the district."

The tidal wave in the Bay of Bengal advances most rapidly in the deeper and central portions. The crest of the wave, which to the south of the Bay is almost a straight line running north-west and south-east between the south coast of Ceylon and the southern coast of Java, gradually becomes more and more curved as it advances northwards. The crest at the head of the Bay is convex to the shore, and the central and more advanced portion of the tidal wave travels from south-west to north-east. It thus reaches the estuary of the Megna later than any other point of the coast. The tidal current is at that time proceeding in a north-easterly direction. At and near the estuary of the Megna it meets with several channels bringing down large quantities of fresh water, and separated by long lines of low islands which are only the highest portion of a shallow area of considerable extent. The advancing tide meets this mass of water at an obtuse angle. The action of the two opposing masses of water is somewhat complicated. The tidal wave passes onwards, slightly deflected, towards the Chittagong coast, and the fresh water in the main channels—the Shahbazpore and Megna rivers—begins to accumulate over the shallows instead of passing seawards. Thus for some hours after the tide has turned, the fresh water continues to flow down in the upper portion of the estuary, and accumulates in the channels lying between the islands, whilst the advancing tide passes onwards to the Chittagong coast and is there deflected up the Sundip channel. Thus on ordinary occasions there is an accumulation of salt-water in the Sundip channel and of fresh water in the other channels—or, in other words, a salt-water tide and a fresh-water tide. The meeting place of these tides is in that portion of the Sundip channel (sometimes called the Baumni Channel) to the north-west of the island of Siddhi and south of Noakholly. Again, when the tide is more than usually strong, as at full moon, or under the influence of a strong south-west wind, or when the river is heavily flooded, the opposing masses of waters accumulate more rapidly than usual over the shallows to the south of the islands, and then the phenomenon of the bore is produced. But whenever this occurs there are always two bores—a salt-water bore, or rush of salt-water up the Sundip channel, known as the Chittagong bore, and a fresh-water bore up the remaining channels, and called by the natives the *daula* bore. These bores, like the ordinary tidal waves, meet to the north of Siddhi. On the east, therefore, of this line of meeting and of the eastern line of islands is the region of salt-water tide and tidal bore, and to the west the region of fresh-water tide and bore. When the conditions for the formation of the bore are peculiarly favourable, it advances as a wall of water stretching across the channels several feet high, and is so dangerous that the native boatmen will under no circumstances venture out into the river when it is expected. As the rapid piling up of the water on the shallows which produces the bore is partly due to the retardation of the advancing tide by the shallow banks of the estuary, and partly to the opposition of the tidal and river waters, it occurs in its most violent form during exceptionally high tides, as at the equinoxes, and also when the south-west wind adds to the height of the tidal wave.

Any other action in the Bay of Bengal which tends to produce a similar accumulation of sea water at the mouth of the estuary will, if sufficiently rapid and large, be accompanied by exactly similar phenomena. Hence the piled-up mass of water at the centre of the cyclone would, by its advance in the same direction as the tidal wave, necessarily produce a salt-water accumulation of water and a bore in the Sundip channel, and a fresh water accumulation and bore in the remaining channels.

The above explanation will make clear the phenomena of the great flood on the morning of the 1st of November over the low land at the mouth of the Megna. It was due to an unusually high tidal wave followed by the storm-wave of the advancing cyclone, and was intensified by the violent north wind which prevailed from 10 P.M. to 3 A.M. and brought down the river water more rapidly than usual, and by the south-west and west winds which immediately followed and impelled a further portion of the storm-wave into the converging water area of the estuary. It was full moon on the evening of the 31st, and there was an abnormally high tide, which flooded all the low lands along the coast of the head of the Bay. At False Point on the morning of the 31st the tide rose two and a half feet higher than on any previous day of the year, and on the same night it rose still higher, and was three feet above the top of the bund enclosing the light-house. In the estuary of the Megna the tide was also unusually high. The advancing cyclone tended to accumulate the salt-waters at the head of the Bay. High water took place at Chittagong at 0-30 A.M. of the 1st. The usual tidal bore at full moon occurred about an hour and a half before high tide in the channels, and was followed by an inundation of the lower grounds of the Chittagong coast and the islands in the estuary. This flooding of the low lands, which took place at 11 A.M. at the entrance of the river, was due mainly to the advance of a higher tidal wave than usual, but was probably intensified by the northerly wind blowing down the river. The inundation was a salt-water one along the Chittagong coast and in the islands of Sundip and Siddhi; over the low lands of the remaining islands and the Backergunge district it was of fresh water. The direction in which the water advanced in the various districts depended, of course, on their height and position with respect to the nearest water. That the inundation, as has been stated, came mainly from the north and north-east is simply impossible. The wind and the ordinary waves at the time were from the north and north-east, but the mass of water which caused the flood came from the south, driven forward by the advancing tide, and produced either a salt or fresh-water inundation in strict accordance with the ordinary phenomena of high tides in the Megna, which have been already explained. This first inundation did little permanent damage, and was not attended by any considerable loss of life. A few persons, it is believed, were drowned, but this is no uncommon occurrence in these islands at high tides.

The pressure of the advancing storm-wave prevented the tide from ebbing and the tidal inundation from flowing off. The storm-wave, like the ordinary tidal-wave, was retarded on the shallows at the entrance of the river. It accumulated there, and finally overpowered the mass of fresh-water brought down by the Megna, which had been unable to find an exit seawards for the previous six or seven hours. It then rushed forwards as a salt-water bore up the Sundip channel and as a fresh-water bore up the other channels. Mr. Porch's account of the inundation, which seems to me to be thoroughly consistent and intelligible, states that this second and greater inundation occurred at the entrance to the estuary, or at the southern extremity of the islands of Nalchira, Badura, and Sundip, at 3 P.M., when the vast mass of water, gradually advancing northwards, flooding the whole area of the islands to a depth varying from 10 to 45 feet. It is very doubtful whether the inundation consisted mainly of a succession of vast waves, each moving forward with irresistible energy, sweeping away houses, trees, and human-beings before it. The excessive violence of the wind from the north-east, which was a marked feature of the cyclone, undoubtedly overturned the majority of the trees, and the direction in which they lay indicates the wind, and not the flood direction. The fact that the crops were only slightly injured by wind and flood, except in the most exposed parts, is utterly at variance with the statements of advancing waves from 20 to 60 feet high. There was undoubtedly a rush of water or bore up the channels, but with the exception of this, the water rose slowly and supplemented the earlier inundation. The tidal-wave had gradually and partially covered the crops in the more exposed districts. This shielded them from the excessive violence of the winds, and the later inundation was not accompanied by a violent rush of waters sufficient to inflict any considerable damage. Mr. Smith, Commissioner of Chittagong, does indeed say that along the Chittagong coast the wave swept everything before it, passing over the face of the country in a body of water 12 feet high. There is no statement of the time at which this occurred, and all that it appears to establish is that there was an inundation preceded by a bore-wave of some magnitude up the Sundip Channel. Mr. Peacock, Commissioner of the Dacca Division, after visiting the islands of Dukhin Shahbazpore, Badura, and the mainland of Backergunge, says:—" It seems almost incredible that the crops should neither have been levelled by the wind nor torn up by the rush of water over them." The reports of all who visited the wave-stricken districts concur in showing that in the area of fresh-water inundation the damage inflicted on the crops was marvellously small, taking into account the violence of the storm and the rapidity with which the flood waters advanced over them. It is impossible to reconcile the fact of the slight injury inflicted on the crops with the passage of huge waves 20 and 25 feet high, and until very much stronger evidence is forthcoming than the testimony of the natives of the district, who were at the time in peril of their lives, amidst a blinding rain and a wind of almost unparalleled violence in Bengal—men who are, moreover, unaccustomed to accuracy either of measurement or of statement—the accounts that they give, affirming that the inundation consisted of a succession of huge waves, carrying all before them, must be rejected as a very inadequate view of the actual phenomena. Mr. Porch's explanation is consistent and satisfactory, and is partially confirmed by some rough notes sent by Mr. Barton, Magistrate and Collector of the Backergunge district.

The phenomena of the bore certainly occurred twice, and may have occurred thrice during the storm. The first bore was at 11 P.M., and preceded high tide; the second was about 3 A.M., occurring immediately before the arrival of the cyclone centre; the third, for the existence of which the evidence is not quite conclusive, may have occurred with the change of wind from north and north-east to south and south-west, after the passage of the cyclone vortex. Each probably consisted of a succession of waves, and was introductory to further inundation. The first wave, at 11 P.M., and the accompanying flood was the least violent in character. It covered the rice and other crops slowly before the wind had become very violent in the more exposed parts near the seashore, and thus prevented the wind from breaking down and destroying the crops, and the succeeding more violent rushes of water from tearing them up. Thus, in the districts which suffered from the fresh-water inundation, little permanent injury was done to the crops, the amount of loss in the majority of cases being less than one-fourth. In Chittagong, the eastern portion of Sudaram, and the islands of Siddhi and Sundip, where the inundation was of salt-water, the effects were much more disastrous. These consequences, the most serious of which were the almost entire destruction of the crops by the action of the salt-water, the prolonged contamination of the atmosphere due to the slowness of decomposition in salt-water, the temporary deterioration of the land by saline absorption, and the subsequent origin and rapid spread of epidemics amongst the surviving population, are very clearly pointed out in Mr. Porch's account (page 168).

Along the Backergunge coast and the islands of Dukhin Shahbazpore, Badura, Manpoora, and Hattiya, the inundation everywhere consisted of fresh water, except at places very near the coast, where it was very slightly brackish. The waves and inundation began at 11 P.M., and the water continued to rise until about 4 A.M., when it began to subside. The greater portion of the flood-water flowed off before 8 A.M. At that time, even in the districts where the depth of the flood-waters had exceeded 40 feet, there was only from one to three feet of water left. The main body of the flood-waters thus retreated even more rapidly than it had advanced.

In the Rabunbad islands the inundation was from 30 to 45 feet deep; the water here came in directly from the south-west. These islands, which are very low and more exposed than any other of the districts at the mouth of the Megna, suffered most severely. The flood was higher than over any other part of the wave-stricken area, and swept off 75 per cent. of the population; the trees were blown down and fearfully torn by the wind, and left leafless.

The Golachipa thana was to a considerable extent protected by the Rabunbad islands which lay to the east and south-east. The waves here came from the open river to the north-east, pouring in until the accumulated waters reached a height of from 15 to 18 feet. The crops were very slightly injured, and are standing, to quote the Collector's words, "in spite of storm-wave and wind. From two to three annas of the *Agrahan* paddy was injured, the rest being a very good crop."

In Badura and the southern portion of the island of Dukhin Shahbazpore the storm-wave poured in a flood varying from 15 to 25 feet high, and came directly from the west and south-west. It was therefore here due to the direct thrusting back of the large accumulation of fresh-water at and near the mouth of the estuary and to the south of the islands. At the village of Dowla, in the island of Badura, the inhabitants state that the waves came from two directions—first, from the north-east, during which the water rose slowly, and afterwards with a rush from the west and south-west. The comparatively slow inundation was probably due to the gradual accumulation of the river waters, held back at the mouth of the estuary by the advancing mass of water forming the storm-wave proper, but driven down in the upper reaches of the estuary by the fierce north-east wind which blew from 11 P.M. to 3 A.M. The latter part of the inundation—the violent rush from the south-west—was evidently due to the forcing back and lifting up of the mass of fresh-water piled up near the estuary by the immediate pressure of the storm-wave and cyclone, and further assisted, after 3 A.M., by the wind, which then changed to south-west. In the northern half of the island of Dukhin Shahbazpore the flood-waters poured in mainly from the north-east. During the early part of the storm this was due to the same causes as have been advanced to explain the north-east wave in the southern portion of the island. The bore and flood-waters at 3 A.M., due to the approaching accumulation at the storm vortex, would advance more rapidly up the channel than over the island itself. Consequently, due to the greater friction of the land, the main body of the flood-water would pour in from the upper half of the wide channel of the Shahbazpore river, and thus came from the north-east, as was undoubtedly the case at Dowlutkhan.

The island of Manpoora, to the south-east of Dukhin Shahbazpore, was one of the districts that suffered most severely. It also appears to have had a slow flooding from the north, followed by a more rapid inundation from the south-west. The flood waters were here 40 feet deep, and carried away 52·5 per cent. of the whole population, of whom the larger proportion were women and children.

The following extracts from the report of the Commissioner of the Dacca Division give fuller details of the loss of life and destruction of crops over this portion of the wave-stricken area:—

"The sub-division of Perozepore escaped the storm-wave, though some damage was done by the cyclone. A good many houses were blown down, and the Deputy Magistrate informed me that about one-eighth of the crops had been injured. From what I could see, however, I think this is rather a high estimate.

"Leaving Perozepore at 11 A.M. on Monday, the 13th, Mr. Barton and I proceeded straight to the sub-division of Patuakhally, which we reached the next morning. The place is a perfect ruin, not a single hut having been left standing. The residence of the Sub-divisional Officer, his office, the Moonsif's cutcherry, the school, the lock-up, the police outpost, the sudder distillery, and the dispensary have all shared the general fate. Notwithstanding the complete destruction of the place, only one life was lost, an old woman's, who was killed by the falling of a house. The crops have been but little injured, the bazar was being supplied as usual, there was no distress, and no unusual amount of sickness of any kind. I may add that the whole of the damage was caused by the wind, the storm-wave not having penetrated so far inland.

From Patuakhally we proceeded to Golachipa thana, the jurisdiction of which extends over about 800 square miles in the south-eastern portion of the district, and which, from its exposed position, we knew had suffered as severely as any place, not even excepting the island of Dukhin Shahbazpore. On our arrival we found that the reports that had reached us had not been exaggerated. Three storm-waves of from 15 to 20 feet high have swept over the place, literally levelling it with the ground. Not a single hut and hardly a post was left standing, while large mandar trees and whole clumps of bamboos torn up bodily by the roots sufficiently testified to the overpowering force of the wind. It is as yet too soon to attempt to compute with anything like accuracy the loss of life which has occurred.

"From inquiries made man by man among a miscellaneous crowd of persons from Golachipa and the neighbouring villages, we ascertained that out of the total number of which their families had been composed, 41·55 per cent. had perished.

"The loss among the cattle has also been very great; I should think not less than 80 per cent.

"Amidst all this misery it is satisfactory to notice that the crops have suffered far less than would be supposed. I do not think that hereabouts the amount of damage done will exceed four or at the most six annas, and this, it must be remembered, out of an exceptionally good crop.

"From Golachipa we proceeded still further south to the Rabunbad islands, amongst which we visited Korulia, Burra Bansdia, and Kujul churs. Here the havoc committed by the storm was very much the same as that at Golachipa, except that, if possible, it was greater, the very *bhitas* (*i.e.* the wooden piles on which the houses are built) of the houses having been broken down. The storm-waves, judging from the drift that clung about the few trees that were standing, must have been more from 20 to 30 feet high. The loss of life has been consequently greater here than at Golachipa.

The result of inquiries made by ourselves from house to house in the three churs abovementioned was as follows:—In Korulia, out of 296 inhabiting 34 houses, 225, or about 75 per cent.; in Burra Bansdia, out of 146 living in 19 houses, 98, or 67·12 per cent. were dead; while in Kujul, out of 21 persons composing five families, we only found four alive. Very much the same result was obtained by the relief officer on chur Rangabolia, another of the same group of islands, where the percentage of deaths was 76. Very few cows or bullocks have escaped. In chur Bansdia, in one house I counted nine, the property of three or four different persons; but I do not think I counted half a dozen more during the whole of my walk about the island, extending over upwards of two hours. Mr. Barton's experience on chur Korulia was exactly the same. Buffaloes being strong swimmers had fared better, but even among them the loss has been very considerable.

"Here, too, we found that the crops had been more extensively injured. In Bansdia the outturn will, I think, be about six or seven annas, in Korulia eight annas, and in Kujul ten annas. There was a good deal of jungle about the last, and this to some extent protected the crops, and accounts for their being better than those on the neighbouring islands. The people all had rice in their houses, but it was all more or less damaged, though quite eatable, and the stocks were not large.

"The next place visited was Dowla, on the western side of the island of Badura, to the west of Dukhin Shahbazpore. This had apparently suffered somewhat less than the Rabunbad islands; the mortality according to inquiries at twenty houses, being 44·36 per cent; the crops, too, were better, and we estimated the outturn at from 10 to 12 annas.

"Rounding the northern extremity of Badura, we then proceeded south down the Gayar river, landed at chur Shumbhoopoora, on the west part of Dukhin Shahbazpore. The crops here are worse than we have found them anywhere, and I do not think the outturn will be more than six annas.

"From Shumbhoopoora we proceeded across the Megna to the island of Manpoora, which we reached at 10-30 of the morning of the 16th instant. Manpoora is another of the places which experienced the full force of the storm, and where consequently the mortality has been great, though not so great as in the Rabunbad islands. Our inquiries showed that in 102 families, consisting of 1,013 persons, 532, or slightly over 52 per cent., had been drowned. Considering what they were exposed to, the crops here are wonderfully good. The early *amun*, sown over about two-sixteenths of the cultivated area, and now being cut, will not yield less than a twelve-anna crop, while the *chuplas* and *bansputi* rice, sown over six-sixteenths and eight-sixteenths of the cultivated area, will yield probably a ten-anna and a nine-anna crop respectively.

"Leaving Manpoora we re-crossed the Megna, and landed first at the village of Kosnuddee, and then at Tozumuddin, both on the east coast of Dukhin Shahbazpore. The former is in a very exposed position, and our inquiries showed that out of 114 persons, comprising 10 families, 46, or 40·35 per cent., have been swept away. The *aghani* crop is fair, and will yield about 10 annas; the later rice appears to have been more injured, and will probably not be more than a five or six-anna crop.

"The next place visited was Dowlutkhan, the head-quarters of the Dukhin Shahbazpore sub-division, where we met the District Superintendent, Mr. Harris. While coming up the khall from the river, a distance of between two and three miles, I counted no less than 76 corpses, though this was the seventeenth day after the storm. The station is a complete wreck. The sub-divisional buildings, the Moonsif's cutcherry, the school, the thana, the lock-up, and the sudder distillery, have, together with the whole bazar, been levelled with the ground. The population being a floating one, it is impossible to attempt to estimate the loss of life that has occurred, though this must necessarily have been very large.

"The following is, I believe, a complete list of the Government officers and servants who have lost their lives:—Moonsif, rural sub-registrar, native doctor, post-master, court sub-inspector, abkaree darogah, two abkaree burkundauzes, seven constables, a mohurir of the moonsif's court, and a post-office peon. Mr. P. M. Gasper, a zemindar, and eight members of the family of the Deputy Magistrate have been drowned, besides many hundreds in the bazar itself. Up to the 17th nearly 250 corpses in a fearful state of decomposition have been drawn out of tanks or extricated from the *débris* of houses in the bazar itself and its immediate neighbourhood, and floated out into the river. Many more must have been swept away altogether, and there are undoubtedly many still undiscovered among the ruins of the place. The atmosphere is in many places simply poisonous; and it is wonderful that some epidemic has not broken out among the people. Most of the tanks are full of decaying matter, animal and vegetable, and it is hard to conceive anything more sickening than the smell arising from them.

"The crops about Dowlutkhan are much the same as those we saw about Kosnuddee and Tozumuddin; the *aghani* rice will be a ten to twelve-anna crop, the *aous* from six to eight annas.

"From Dowlutkhan we proceeded up the east coast of the island, landing at Goneshpoora, in the north-east corner of it, to inspect the crops, which are much the same as at Dowlutkhan. From thence we went to Bhola and Ruttunpore, places situated respectively about four and six miles inland on the north-western part of the island. Here there had been hardly any storm-wave, and no loss of human life, though a few cattle had been drowned.

"Our next point was Bowful. Hardly a single kutcha house has been left standing, and though the storm-wave was not nearly so high here as in the Golachipa thana, Dukhin Shahbazpore, and Manpoora, the loss of life has been very great. About one-fourth of the entire area of the thana, 194 square miles, was subjected to the fury of the storm, and the deaths in this portion of it, roughly estimated to contain between 27,000 and 28,000 people, are computed to be about 7,000.

"The last place visited was Kujlakatty, in the Backergunge thana, where there has been considerable loss of life and destruction of cattle, though nothing so serious as in many other places.

"There are two most providential circumstances about the late storm—*first*, that the crops were not utterly destroyed; and *secondly*, that the storm-wave, or rather succession of waves (for there were three), was composed of fresh and not of salt-water. It seems almost incredible that the crops should neither have been levelled by the wind nor torn up by the roots by the rush of water over them. At first I was inclined to think that, as for some time before the waves came the water had risen steadily, they might have been merged before the former passed over them, and had thus not felt the violence of an immense volume of water being suddenly thrown upon them. But this theory, it is clear, can only apply to places over which the storm-wave or waves passed, while the crops are standing just as well in places which only experienced the force of the wind. In some places no doubt they were protected to some extent by surrounding belts of trees and jungle, but in many others I saw wide plains of miles in extent which had no screen of this kind. Whatever may have been the cause, it is certain that the crops have not been laid, and in this fact lies mainly the removal of anxiety as to the condition of the people. With regard to the second point, the water being fresh, no injury has been done to the land, except possibly from a small deposit of sand upon it, and even this we saw nowhere. Instead, too, of all the tanks being made brackish and undrinkable by an infusion of salt-water into them, we found no place where there was any want of drinking water, notwithstanding that so much of it had been contaminated in other ways. The calamity is bad enough as it is, but had the above circumstances not attended it, or had it occurred a month or two earlier in the year, it would have been infinitely worse."

Mr. Porch, Collector of Noakholly, thus describes the inundation in his district:—

"The inundation, the direct effect of the cyclone, was the cause of the catastrophe here. I therefore beg to offer the following observations and local experiences on the subject of the inundation. A map is sent herewith to illustrate the subject further. (This is included in the map of the wave-stricken districts. J. E.).

"This part of the country, from its lowness and exposed face, as gradually formed towards the south in the Bay of Bengal, has always suffered from time to time from inundation. The tides at full moon and new moon and the equinoxes produce inundations sufficient to destroy the crops over large areas when there is a wind from the south in either quarter, and there is thus a conjunction of wind and wave. According to the time, duration, and direction and strength of the wind at these junctures the inundations assume fearful dimensions. On this subject I beg to refer you to the closing paragraphs of an article on Noakholly at page 340 of the *Statistical Reporter* for May 1876:—

"'A remarkable feature of the Noakholly district is the *bore* or tidal wave that traverses the channels leading into the Megna. It makes all the water dangerous at times from the Bhowanigunge khal to the east coast of the Sundip channel. At every full and new moon, especially at the time of the equinoxes, the bore lasts for some days before and after, and has to be carefully reckoned with by those whose business is on the water. The tide as it runs up the Bay is confronted by Sundip and Hatiya and the churs between, and the current is divided. The main current speeds away to the right up the Fenny river, and the remainder round by the coast to the west, where, north of Hatiya, it is met by the left or counter-current, which, after swerving round Hatiya, has been deflected in that direction by the west coast. The united volume of water rushes on like a white wall from 14 to 20 feet in height, at a pace of about 15 miles an hour, until exhausted at the eastern limit above the Bhowanigunge khal, as far as Raipur on the Dacootia. The bore is the creation of the churs; but besides this, there are whirlpools occasionally formed, and strong eddies and rushes of water are encountered in the channels about the islands in bad weather, especially when there is a strong southerly wind at the beginning and at the end of the rains. The water is then sometimes blown in a heap and rolled miles in on the islands and on the mainland.

"'Nulchira, on the south of the island of Hatiya, suffers periodically from an inundation of salt-water. It is the south-east wind for the most part that brings the salt flood on the islands and kills the crops.

"'The south-west hurricanes during the equinoctial gales do much damage. In the cyclone of November 1867 the storm-wave swept right over the island of Hatiya from end to end, a distance of about 25 miles.'

"The left-hand or western tide—the Daula—is composed of rather fresh-water and makes first. The right-hand or eastern tide—the Chittagong tide—is the stronger and is entirely salt, and goes round the Sundip channel somewhat after the Daula or western tide. When the wind is in the east, or more especially south-east, the Chittagong tide floods the east and south-east coast with a salt inundation.

"This occurred at about 11 P.M. on October 31st, when all the people of the east and south-east coasts of Sundip, Hatiya, Bamni, and Sudharam thanas were put in great danger and had to get on the roofs of houses and up into trees for safety. Very little loss of life has been ascertained to have occurred then from the salt inundation from the east at the "flood-tide and bore-time" before midnight. The naib of Nilakhyi (Bhulua estate) in Hatiya and his family were drowned at this time in four feet of salt inundation, it appears, by their house falling upon them and pressing them down into the water.

Some people whose boats were wrecked at this time were drowned then also. In these coast parts people remained aloft all night on trees and house-tops or floating roofs or similar things, owing to this inundation from the east. It was this commotion in the water from the east that, with the bore, wrecked Mr. Higgins' boat when the wind had veered from north-north-east to the east and south-east. This was a truly critical time for the station of Noakholly, but the wind changed quickly from south-east to east and north-east and kept the water off. After that the wind blew from about 3 or 3-30 A.M., or after, from the south-west and west (below the Megna across the islands), and drove ahead all the fresh-water and diluted salt-water of the Daula tide heaped up in the channels of the Megna by the wind blowing from the north and the tide pressing in from the south. The south-west and west wind lifted up all this water and drove it over the channels and the islands from the south-west to north-east at about 3 A.M., or 3-30 A.M., or 4 A.M., according to locality, carrying away almost everything in that direction, and thus inundated all South Noakholly, viz. the islands on the south and the mainland to the north up to the dotted line in the map (which corresponds nearly with the main road running across the district from Raipore west to Lalgunge east), except near the mid-Fenny tract, where, from lowness and river-face exposure, the water was carried up further north by the wind and the tide. Here the bulk of the countless dead of all descriptions and débris of houses were swept up, but were again for the most part carried out to sea as the tide flowed back to the south and south-east.

"Fortunately the cyclone blew from north-east against the tide during most of the time the tide was flowing in (people felt themselves safe then). Towards the end of the 'joar' or flow-tide the wind turned, as before stated, and lifted up and carried the heaped-up half-fresh water of the western channel over the exposed country, part of which had already suffered from the salt inundation from the east. It flowed on over islands, churs, channels, and became salter as it went north-east, where it dashed in over the banks of the Fenny and the Chittagong coasts on the east.

"Had the cyclone, just as it blew, taken place four hours earlier, the station of Noakholly would, there is reason to believe, have had twenty feet of water over it, and the inundation would probably have reached the old factory road above Begumgunge, Gopigunge, and Dewangunge. Along this line there are many very highly-embanked tanks, probably made scores of years ago to meet a calamity of this kind, as the result of experiences that have long since been forgotten, but revived by this recent disaster; moreover, in that case the inundation would have lasted some hours longer, and the destruction of property and life would have been proportionately greater than it has been owing to the rapid subsidence of the flood, as the wind at Noakholly veering to the north at about 6-30 A. M., just after the turn of the tide, helped to carry off the flood, and then gradually fell. A consideration of the facts noticed about wind, tide and time, and physical features of the country make this seem probable.

"Looking at the line of very-highly embanked tanks of great size along the old factory road, it would seem that, with a view to meet the calamity of a widespread salt inundation, such tanks were dug and embanked in former days, when the sea or river coast was many miles inland on the north. A cordon of the existing tanks along the lower road, the line of the recent inundation, should be highly embanked to supply fresh-water to the coast people in case of a like visitation in future.

"As such cyclones may occur at these seasons, this part of the country will always be liable to flood by inundation, especially at the time of the equinoxes. The autumn flood in Kartik (October and November) will be most destructive in its after effects from its saltness, which will bring much cholera and other disease and will destroy most of the produce. The spring flood in Jyesta (May and June) would be the highest probably, and would cause more loss of life by drowning, owing to the rivers and the estuary being very full then, but it would be a comparatively fresh-water overflow, much less brackish than the autumn flood, owing to all the fresh rivers converging on the Bay, and largely diluting the salt-water; so that the after-consequences of a flood then, with the rains immediately following, would be less disastrous to the country at large than the comparatively less volume of the salt inundation of the autumn.

"The great inundation at 3-30 A.M. in the south and at 4 A.M. in the north of the islands, and at 5-30 A.M. at the station of Noakholly, was caused by the very high tide at the full moon with the Chittagong bore and the Daula bore, and was very much increased by the commotion caused in the Bay from the changeableness of the wind and probably from the previous stormy weather out in the Bay. This had caused inundations on various parts of the coast at about 11-30 P.M. of that night. The wind from the north-east in the first part of the storm had also driven down much of the fresh river-water from the Megna and other rivers into the channels of the estuary, where it was heaped up by the pressure of the incoming tide, causing considerable inundations on the coasts of these islands. When the wind veered round to the south-west and west at about 3-30 A.M., 4 A.M., and 5 A.M. according to their position (at Nulchira, furthest south, it blew from the west at 3-30 A.M.), it forced this mass of water from the estuary of the Megna over the adjacent country and islands, causing an incursion of the river and the sea from the direction of the south-west to the north-east. This caused the destruction of property and calamitous loss of life. What saved the people and cattle from almost universal destruction over even a further area north of Noakholly was, first, the cyclone did not blow from south during the flood-tide; it did not blow long from the south-west and west, and then only towards the end of the inflowing tide. The ebb soon came and the water ran off. It occurred only two or three hours before daybreak, and there was clear moonlight then. It was full moon, so there was moonlight all night everywhere except when the different localities were darkened by the storms of rain.

"From this it will be understood how that inquirers from survivors in Hatiya, Sudharam, and Bamni might hear that at one time in the night salt-water came and inundated the houses and tanks, and that a few hours after a fresh-water flood came. At Hudrakhali, east of Sundip, at 11 P.M., by the east wind and heavy sea breaking in, four or five *gada* boats were loosed from their moorings and swept away with the men on board. People then had to climb up trees and remain there to save themselves until next day. One man stated:—'It was about midnight; the sea was very high and tossing about and coming in over the coast. I was up in a tree, and as the wind blew from the east and south-east, the water came rushing in, and with such force that I thought no place would be safe and nothing would be saved. I saw a large mass of water like the bore coming up the river as high as the tree I was on. I expected to be soon swept away by this water, but the wind suddenly came down from the north. It looked dark as it dashed against the wave, and both wind and wave stood still for a time opposed to each other, and the wave rose up to 60 feet high and then fell back, driven by the wind to the sea, and so I escaped.' It does not appear to be correct to speak of the flood (between 3-30 A.M. and 5-30 A.M. according to locality) in the second part of the cyclone from the west as a 'storm-wave,' for the water came on advancing and rising like the tide. It was a regular inundation, and not a mass of water like a 'storm-wave,' or like 'the bore,' though it sounded something like the bore as it flowed in. It was a storm-wave in the correct sense of the word which wrecked Mr. Higgins' boat at 11-30 P.M. or midnight during the first part of the cyclone, when blowing from the east and south-east."

The following extracts describing the character and extent of the inundation along the Chittagong coast are taken from a report submitted to Government by the Commissioner of the Chittagong Division:—

"In the southern half of the district—that is south of the river Kurnafoolee—there is no distress requiring any immediate help. The Magistrate reports that rice is selling along the sea-coast, which in that part of the country had the worst of the cyclone, having been visited lightly by the storm-wave, at 13 seers a rupee, and that the neighbouring hâts are being well attended. Those living nearest the sea have indeed lost their crops, and a few unfortunates have had their property washed inland with no great chance of finding it again. There has also been a heavy loss in cattle, but I do not think that advance for the purchase of cattle will be very necessary there. As was anticipated, the water in the tanks is becoming sweeter, and it is hoped that in a few days more the people will have no want of drinkable water.

"At Kootubdia the crops are reported to have been very badly injured, and all round scarcely a six-anna crop is estimated by the Sub-divisional Officer of Cox's Bazar, who personally visited the island.

"The sea is said to have risen 12 feet above its ordinary level, and the whole island was under three feet of water. The Government khas tehsil, cutcherries, and native houses have generally been blown down, and the house of the superintendent of the light-house, with a portion of its protective revetments, has been carried away, only a masonry wall of the former surviving the wreck. The light-house itself is reported to have rocked, but has stood well. To remove the very generally felt want of sweet water, the Sub-Deputy Collector stationed there has been directed to sink wells. No loss of life is reported from this island, but houses in the northern part of it are said to have been washed away, while no vestige is left of any embankment, artificial or natural.

"The western shore of the island is strewn with the dead bodies of human beings and cattle, nearly 300 of each.

"In the northern half of the district, with the exception of Kumaria and Sitakoond, there is nothing very exceptional beyond the usual damage more or less to crops, and the general destruction of houses everywhere. Later reports from Kumaria and Sitakoond, though still gloomy, are much more hopeful, and show that the crisis, as far as the immediate effects of the cyclone is concerned, has been tided over.

"The state of the western half of these two thanas is thus described by Mr. Assistant Collector Pargitar, who is still on deputation there for purposes of relief:—

"'The storm-wave swept right across the country in an easterly or north-easterly direction, reaching everywhere, except at Kumaria, as far as the Government road, and wherever the road was low it passed across over the land to the east. The quarters from which the cyclone blew with the greatest violence were west and south. The wave passed over the road between Kumaria and Sitakoond at two places,—one being Kuman Ali's hât, where the damage was greater. Generally, the damage seems to have been the greatest from this hât to some miles north of Sitakoond, and the marks of destruction are most abundant for two miles north. The wave swept everything before it, passing over the face of the country in a body of water about 12 feet deep to about three-fourths of a mile from the high road. Everything was swept onwards by it in its course, and the broken remains of boats were carried two or three miles inland. People were washed over from Sundip and supported themselves on roofs of houses, planks, bamboos, &c. Many children are said to have perished on the way. The people on the mainland here who could do so mounted the largest trees they could find, and remained there until the water receded. There is not a single house left standing, and the contents of the houses were carried off and scattered far and wide. I have seen about fifty corpses myself, besides hundreds of dead cattle of every kind and the dead bodies of many birds. The reported number of deaths at first was very high, the people saying that at least one-half of the inhabitants had been drowned; but they must have included the number of those who fled eastward and thronged the road. Now that all these persons have returned to their houses, the number of those who really perished in the storm can be ascertained with tolerable accuracy, specially since the matabars have had to distribute the rice to the survivors. I have inquired of many mohullas the number of persons who perished in the cyclone; the total number for about fifty mohullas, subject to this outpost and containing about 4,000 houses, is about 1,900 persons; hence it would appear that (allowing 5½ persons to each house) the mortality among human beings has been 8·5 per cent.

" 'It is not to be supposed that all these bodies have been found or are to be found. Large numbers have been found and buried, others still lie here and there unseen among the fields, but without doubt very many must have been carried out to sea on the reflux of the wave.

" 'The mortality among the cattle has been immense, and I think that at least one-half have been destroyed. They lie about the country in large numbers, but more must have been swept out to sea.

" 'Sitakoond was filled with pilgrims at the time of the cyclone, and owing to the destruction of the houses and the overcrowding greatly increased thereby, cholera broke out. As soon as the storm was over they began to vacate the place, mostly in a northerly direction, whence the greater number had come, and the virulence with which the disease would otherwise have raged has been checked thereby.

" 'The wave, as I have before said, swept the whole of the country to the west of the Government road, and all the crops there will be destroyed. As one proceeds in a westerly direction the fields are found to be inundated with salt-water, which at a distance of a mile from the sea-shore is generally a foot deep, in some places much more, and the depth increases with the proximity to the sea. The crops this year were superior to those of several past years, and the cultivators were anticipating a gain therefrom which would recoup them for former bad harvests. Those near the sea were more advanced than those inland, and would have been fit for reaping in a few days.

" 'Wherever the wave has passed over the road to the east side, the same results, though in a mitigated form, will follow as on the west; but the wind has there blown out of the ear all the ripening grain and has extracted the juices of the young and growing crops. The cultivators say these are ruined, and that they will obtain no harvest this year. It is possible that the latter may recover and produce some grain still; it will be but poor. It is difficult to give a precise statement; I suppose about one-third of these crops are not yet in flower.

" 'I visited several houses yesterday, and made a thorough search into all I could find there. Each person has sought for his property and brought it back when found; and on discovering the *handis* containing his grain, has searched the ground near. Whatever grain he has thus found (often almost grain by grain) he has carefully washed, sifted, and dried in the sun, and then stored away again. The labour bestowed on preserving the grain is sometimes surprising. Some grain has begun to germinate, but it is dried and then kept. Other grain of last year which has been much damaged is first dried in the sun, then boiled, dried again, and put away. So too with regard to chillies, kuddus, suparis, and other articles of food. Clothing of all kinds has been dried carefully in the sun, and cotton has been picked, separated, dried, and put away. In every *bari* which I visited I found a maund or two of rice, Pous or Shail, or of all together, and sometimes as much as five or six maunds. There was besides a jar of chillies or suparis, and sometimes a small file of kuddus, or a small pot of dried fish. All these articles, however, have been soaked in the salt-water and are more or less injured.'

"Tanks in these parts also have been rendered brackish by the influx of salt-water, and many of them being polluted by dead bodies, bamboos, grass, and débris generally, have become pestilential pools. Fortunately there are many springs and hill streams on the eastern side of the Trunk Road, but as they are not within easy distance of every place, Mr. Pargitar fears that the people will have recourse to the impure water at their doors instead of resorting to the purer supply at a distance, adding one to the many unavoidable causes of sickness. Cholera is unfortunately raging very virulently over this part of the district, and in fact exists generally wherever the salt-water had access.

The prospect of the cold-weather crops in the Chittagong and adjacent districts is thus described by Mr. Pargitar:—

"'According to the general accounts of the inhabitants there is no prospect of any cold-weather crops being obtained. The ground, they say, has been so impregnated with salt from salt-water that it will remain sterile until fertilized by the rains of next year. They expect then to obtain a moderate harvest, but the earth will not regain its former fertile condition for two years. They have no seed fit for sowing, and they say that if they were to sow all their fields they would reap but a paltry harvest, receiving less probably than they had sown. This disastrous condition is rendered more so by the loss of their cattle; many of the cultivators are absolutely destitute of the means of ploughing and tilling their land, and those who have lost beasts will still be straitened in cultivation of their fields. Their implements of agriculture have also been lost or destroyed, and the broken remains of ploughs are to be seen along the roads.'

"'Mr. Sarson thus describes the state of Sundip:—The whole place looks as if it had been on fire, and the whole vegetation, including the large trees (such as mango, jack, cocoanut, &c.), seem burnt up. There is a regular look of desolation in every direction you turn your eye. This southern part of the island is said to have suffered more than the northern. The water is said to have risen twelve or fifteen cubits by the native account, but I took the trouble to measure those trees in their different places on which rubbish had been deposited when the tide receded, and found it to be eleven, thirteen, and fifteen feet, according to the rise and fall of the land; the average may therefore be taken at the least at twelve feet. Such a body of water rushing over the land must have been most disastrous and terrific, and the effect has been, as may be imagined, the loss of hundreds of human lives and of cattle, and the destruction of every house in the place. The houses have not been simply blown down as in Chittagong, but have been literally carried away, no one can say where, and large boxes have also been washed away. With regard to the growing crop of paddy on the land, I should say that the people will get about four annas in this part of the island. There will, however, be cases in which some persons who planted late will loose their all, but on the whole the crop will be a four-anna one, and it is now ready for cutting. Grain, however, in the ear is not so fully developed as it would have been had it been allowed to mature another fortnight, but the people need not starve.'

"As regards the damage done to the port of Chittagong, the Conservator has submitted a report from which it appears that all the principal buildings and the buoys have escaped without any injury worth mentioning, only the boats and kutcha buildings having been somewhat injured. The port jetty, as already reported, is a complete wreck, and orders have been issued to put up the screw-pile one, the stores of which are lying in Calcutta.

"As to the shipping, the two vessels that were reported as missing have since turned up, and it has been definitely ascertained that only one native vessel was lost in the storm. The European vessels, with the exception of two, seem to have escaped any very material injury, and will shortly be refloated. The Commissioner's steamer and flat and the Magistrate's schooner have been got into the water, but one of the pilot cutters and a Government budgerow are still aground. Mr. Warden estimates the damage done to the rice stored for shipment at 56,000 maunds, equivalent to about Rs. 84,000. About 50,000 maunds of rice were afloat on the night of the cyclone, of which only about 8,000 maunds will have to be relanded for executing necessary repairs to the vessels containing them. Besides this, of 50,000℔ of tea stated to have been stored for shipment, about 17,000℔ have been damaged, and about another 22,000 have suffered more or less from inundation.

"Mr. Warden's remarks regarding the gloomy prospect of the trade are quoted *in extenso* for the information of the Lieutenant-Governor:—

"'However serious the damage done by the cyclone to the shipping in the port (and of course necessarily it is very considerable), the injury is as nothing in comparison to the loss to the trade and the gloom cast over the business prospects for the year, both of which were most promising, and seemed pregnant with abundance and prosperity to all engaged. All the preliminaries had been settled for establishing a direct trade in jute between Naraingunge and Europe *viâ* Chittagong, and which doubtless would soon have been followed by the addition of many, if not all, of the other products of Eastern Bengal which are now exported to Europe by the longer and very much more expensive route of Calcutta. The rice was beginning to come in copiously, and whatever differences there had been between the vendors and buyers of rice had been laid aside, either permanently or forgotten for the time being, and confidence was felt in a lively resumption of the trade of the port of Chittagong which had been languishing for the past three years owing to the pressure of exceptional circumstances, which, differing in themselves in each of the years of decline under allusion, are no criterion of a permanent decline of the trade.'"

The inundation of the Chittagong and Noakholly coast districts, and of the islands of Nulchira, Hatiya, Sundip, and Siddhi, was in one part fresh-water and the other salt-water, with an intermediate region along the Noakholly coast, where the flood became more brackish towards the east.

The mainland of the Noakholly coast along the borders of the Megna to the west of Noakholly and chur Sikander and the islands of Nulchira and Hatiya experienced only a fresh-water flood, whilst the area to the east of these, including the eastern portion of the Noakholly district along the Sundip and Fenny rivers, the Chittagong coast districts as far south as the island of Kootubdia and Cox's Bazar, and the islands of Sundip and Siddhi, had throughout a salt-water inundation.

The reports given above and the information supplied by Baboo Sreenath Ghose (p. 143) show that the inundation commenced about 11 P.M. and was due to the high tide. It was preceded in this part by the usual bore,—the Chittagong (salt-water) bore,—which flooded the whole of the lowlying districts nearest the coast. This was followed by the greater inundation due to the storm-wave, which began from 2 A.M. and continued to pour in water until 6 or 7 A. M., according to the position of the district with reference to the cyclone vortex. It came on slowly at first in the more westerly districts, as in the Backergunge districts, but with the change of wind to south and south-west, the flood-waters were poured in very rapidly from 3-30 A.M. to 4-30 A.M. or 5-30 A.M. This second and further inundation was preceded and probably accompanied by large waves resembling the usual bore in character, due, first of all, to the storm-wave overpowering the accumulating waters at the mouth of the estuary, and afterwards to the change of wind driving up the waters into the confined channels of the estuary. There were thus probably three great rushes of waters during the storm : the first at 11 P.M., in advance of, and due to, the tidal wave; the second between 2 A.M. and 3 A.M., preceding the arrival of the crest of the storm-wave at the entrance of the estuary; the third between 4 A.M. and 5 A.M., produced by the action of the south wind pressing an additional portion of the mass of the storm-wave into the confined channel of the Megna and causing a further increase of the inundation. These appear to be the three waves or rushes of water which Mr. Smith, the Commissioner of Chittagong, describes as occurring along the Chittagong coast. The character of the inundation at the various parts of this area is intelligible by taking into account the action of the accumulating river-water in the estuary, the tidal wave at midnight, the cyclone wave, the crest of which advanced with the calm area at a rate of about 20 miles an hour and reached the entrance to the estuary at 3 A.M., and the change of wind from north-east to south-west over the greater part of the estuary with the passage of the storm centre.

Along the Chittagong coast the flood-waters came entirely from the west and south-west. In the more southerly of the islands, including Sundip, Nulchira, and South Hatiya, the inundation came mainly from the south-east. This direction was partly determined by the wind direction on the eastern quadrant of the cyclone, and partly by the north-eastward motion of the advancing mass of the storm-wave at the entrance to the channels by the side of the accumulating river-water to the north, which tended to pile up the waters along the Chittagong coast, from which they spread to the north and north-west. The flood at Siddhi, as in the northern portion of the island of Dukhin Shahbazpore, was mainly due to the accumulating mass of river-water held back in the lower reaches by the storm-wave and driven down in the upper reaches by the violent north-east wind. The inundation here began from the north-east at 2 A.M. Afterwards, when the cyclone had passed over the island, bringing with it the crest of the storm-wave, the flood-waters came from the west and south-west. At Noakholly and in the districts bordering on the Fenny river the flood poured in before 5-30 A.M. was not very considerable. But at this time the crest of the storm-wave was to the north of Siddhi, and the mass of waters brought forward by it advanced from the south and flooded rapidly the whole of this district. The effect of the north-east wind in bringing down the river-water is shown by the character of the inundation at Ramgunge, some miles to the north of the district directly flooded by the tidal and storm-waves. Here the fresh-water flood was due to the wind bringing down volumes of river water which found its way up the numerous channels, and refilled the dried-up khals and marshes and the surrounding lowlands which form the natural drainage of the district. This caused a flooding of the country and a disturbance of the ordinary conditions of surface water and subsoil moisture at this season. The rice crops have been considerably injured and the public health has suffered much from choleraic disease.

The following is the report of the Master Attendant of the Port of Chittagong of the storm and inundation:—

"The barometrical readings for two days previous to the passage of the cyclone registered indications of a change of weather, as it fell from 29·90 at 4 P.M. of Monday, the 30th October, to 29·69 at the same time of Tuesday following. Measures were therefore adopted to warn the shipping in time; but, owing to the storm-wave, the vessels started their anchors, which necessarily resulted in their dragging and ultimately getting ashore. Rain was much wanted and had been anxiously awaited for weeks past to perfect the fine and promising crops into yielding a rich and abundant harvest; and the weather, which had been overcast for some days previously, at last seemed to betoken the much-invoked rain which is customary at this season of the year.

"Towards 8 P.M. of the 31st ultimo, however, it became evident that more than rain portended. The wind was blowing in 'fitful gusts' from the north-east—a most suspicious quarter for the time of year. The barometer stood at 29·75, showing a downward tendency. There was little or no scud at this time, and the clouds had a slow rotatory sort of progression from east to west. Thunder was occasional and the lightning was forked and very vivid, the wind increasing at each gust and the barometer falling steadily. At 11 P.M., after a lull, the wind suddenly shifted east. So the weather continued till 2 A.M., by which time the storm had developed into a perfect hurricane, the wind increasing and the barometer still falling, when, with a shift of wind to east-south-east, trees, houses, godowns were all now being torn to pieces by the violence of the wind; yet most of the people remained at home, and the shipping, notwithstanding the wind, still held on in safety to their anchors. Within 30 minutes afterwards the wind had shifted to south-east. The rain was driven before the raging of the tempest into a dense mist more impenetrable then darkness, and the terrors of the cyclone which swept over the port were enhanced by finally culminating in a storm-wave. It was high water at 12-30 A.M., and the tide, which should have ebbed for two hours, suddenly rose three feet above the Government road (which is considerably higher than the adjacent lands and high-water-mark). The vessels started from their anchors and were drifted about at the mercy of the wind and waves, the latter of which in a short jumping sea broke over the largest vessels in port. The vessels were fouling one another, and, as a consequence, the port was soon entirely cleared of its shipping, save one American barque, which happened—strange to say—to have been anchored in shallow water. People were in water from their knees to their armpits; their houses were inundated as well as roofless, and now the great loss of life occurred. The wind at 3-30 A.M. shifted to south-south-east. The barometer was down to 29·27, and so continued to fall to 29·25, the cyclone all the time raging with the greatest fury and devastating the whole place. At 4-30 A.M. the wind veered south, the barometer having risen to 29·29, but the wind continued unabated to carry all before it till 5 A.M., when it again shifted to south-south-west: barometer 29·35. At 5-30 the weather showed the first faint symptoms of clearing: wind at south-west, barometer risen to 29·45.

"By this time, however, all the vessels except one had dragged their anchors and were aground on the northern bank of the river; some of them had lost boats, some their rudders, and all had sustained damages of a more or less serious nature, and one had sunk in the river.

"The jetty had been carried away and was a complete wreck; the departmental boats were long since stranded far inland; the shores were strewn with the results of the cyclone, carcasses were lying about, bodies drifting in the river, and people struggling for life in the water."

The following extracts from Sir Richard Temple's report to the Government of India of the cyclone and storm-wave give a graphic description of the appearance of the wave-stricken area a few days after the cyclone, and furnish the only authoritative statement yet published of the probable loss of life:—

"There was a severe cyclone in the Bay of Bengal on the night of the 31st October. But it was not the wind which proved so destructive, though that was bad enough; it was the storm-wave, sweeping along to a height from 10 to 20 feet, according to different localities; in some places, where it met with any resistance, it mounted even higher than that.

"In the evening the weather was a little windy and hazy, and had been somewhat hot; but the people, a million or thereabouts of souls, retired to rest apprehending nothing. But before 11 o'clock the wind suddenly freshened, and about midnight there arose a cry of 'the water is on us,' and a great wave burst over the country several feet high; it was followed by another wave, and again by a third, all three rushing rapidly southwards, the air and wind being chilly cold. The people were thus caught up before they had time even to climb on to their roofs, and were lifted to the surface of the water, together with the beams and thatches of their cottages. But the homesteads are surrounded by trees—palms, bamboos, and a large thorny species called madâr. The people were then borne by the water on to the tops and branches of these trees. Those who were thus stopped were saved; those who were not must have been swept away and were lost. Doubtless there must have been variation in detail in this struggle for life with death; but there is an extraordinary sameness in the general manner in which people were saved or lost. In most cases they would show us the particular tree on which they stuck, and generally the survivors pointed to the severe scratches they received from the prickly branches of the madâr trees; in reality these thorns and prickles held them tight, as if with natural grappling-hooks, and prevented them from being borne away.

"The mode of habitation is in this wise. Each hamlet consists of four to six houses (to each house a family); these are built (thatch and matting) on a slightly raised platform composed of earth thrown up from the surrounding ditch; they are surrounded by a wall of trees, high and dense. It was this formation, unvarying in kind, though varying in degree, that prevented the loss of life from being universal. Indeed, the trees, in their long stretching arms, held up the poor drowning souls. In those hamlets where the trees grew thickly many lives were saved; in those hamlets where there happened to be gaps or breaks in the environment of trees, most of the inhabitants were carried off.

"The bodies of the lost were carried to considerable distances, where they could not be identified. Most homesteads have dead strangers lying about, washed in from distant villages. The corpses began to putrefy before the water cleared off the grounds, so they are left unburied in numbers all over the country (in a Mahomedan population there is no cremation). They are indeed masses of corruption which no one can bear to approach, and they present a sickening spectacle. Mixed with human bodies are the bodies of cattle, all heaped up together. The smell in many places was distressing to us as we walked through the fields from village to village. Weather-tossed seamen in the Bay of Bengal saw many corpses floated out from land with the waves. Corpses from the Sundip island were flung on to the seashore at Chittagong; and living persons were borne thither across an arm of the sea, clinging to the roofs or beams of their own houses, as if upon rafts.

"As an authenticated instance (as described to me by the witness) of the suddenness of the onset of the storm-wave, I may mention that Mr. Higgins, an Inspecting Postmaster, was in his travelling barge that night, moored in the creek near Noakholly about 10 miles inland from the Megna. He had gone to bed that night at 11 o'clock without any fear or anxiety whatever; the boatmen were ashore, but his four native servants were on board with him. Shortly before midnight he was awakened by a cry of 'the waters are up;' jumping up he looked out and saw a high wave, with its crest and curling top gleaming in the starlight, it seemed like a flash. In an instant his boat seemed rising up on high; he fastened on a life-belt; in a few moments another wave came rolling on, and the barge capsized; he paddled about in the water all the rest of that night with the help of the life-belt; the native servants clung to spars—three were saved, one was lost. The water felt warm to the body, but the air was bitterly cold to the head or hands above the surface. Of some natives lodged on the branches of a tree, one was seen to relax his hold from cold and numbness and sink into the flood.

"If this happened at Noakholly, what must have been the emergency in the islands still more exposed to the fury of the storm.

"The force of the inundation appears to have lasted in most places from about midnight to 2 A.M., that is for two hours; by daybreak there was much subsidence of flood, and by noon next day the survivors had come down from the trees and regained *terra firma.* But they must have been foodless and shelterless for the rest of that day and all the next day. After that, however, they began to re-assemble, not indeed at the ruins of their homesteads, which had been carried away entirely, but at the sites and foundations. They took out their stores of grain buried in pits, dried those which were wet—the sun having come out in the cleared sky—and cooked such as were undamaged. At every homestead which I visited I found the people engaged in drying their grain. They also made frameworks with broken branches, over which they threw sheets and cloths such as they had about them at the moment, and so made little tent-like habitations. Plantain trees abounded, but the fruit was mostly destroyed. The cocoanuts, however, very frequently stood through the storm, and must have afforded some sustenance. There must have been much trouble about water at first. But either the drinking tanks speedily recovered from the brackishness left by the salt-wave, or else the storm-wave must have mainly consisted of fresh water; for the drinking tanks were not brackish when we tasted them a few days afterwards. It was a great relief to find that such was the case. Some tanks and some swamps indeed are full of human corpses and dead cattle and all manner of fœtid matters, and cannot be approached; the streamlets which carry off the accumulated water were flowing black and thick with putrid substances.

"No estimate can be made of the number of cattle drowned. They are chiefly bullocks and cows, some few are buffaloes; but the buffaloes are mostly saved, being excellent swimmers. The loss of cows is bad for the people, and the loss of oxen is still worse for agriculture. Fortunately there is no immediate demand for ploughing in the fields, so the loss will not make itself severely felt for some months.

"For the first day or two after the catastrophe there were some attempts at plundering and some lawlessness broke out, but all this was promptly suppressed. Gang robbery used to prevail formerly in these tracts, and the robber spirit still survives among the instincts of the people; the fear was that, unless authority could be quickly vindicated, many persons would be tempted to take advantage of the sudden disruption of all social bonds to superadd crime to the many evils already inflicted on the land by a physical visitation.

"Most of the local native officials were drowned, deputy magistrates, police inspectors, native civil judges, notaries, and others. Of those who escaped, some stood by their posts and did their duty well. Some few deserted and fled for their own safety, forgetting their charges; these, however, belonged chiefly to the lowest grade of the police. There were few resident landlords and few land agents on the spot. The villagers mostly consisted of cultivators with various kinds and degrees of tenures and of sub-proprietors—a substantial yeomanry in fact—and they were the richest peasantry in all Bengal.

"When the storm burst there was an abundant rice crop ripening for the harvest—the well known deltaic rice crop, which is much beyond the needs of local consumption, and affords quantities (measured by thousands of tons annually) for exportation to distant districts. A part is lost, that in which the plant had not advanced beyond the stage of flowering, and a part is safe still, that in which the grain had formed or begun to form. If even one-third is saved, that would suffice for the population now on the land.

"The boats, great and small, which constitute the only carriage in these tracts, and which fill the place of carts, were all lost on the night of the storm, jammed and smashed up together, or wrecked, or disabled, or carried inland and left high and dry. The Noakholly authorities were thus bereft of all resources for moving across the floods. In the case of the Hatiya island this was very hard; by reason of the loss of all boats there were no means of crossing the Megna to reach the island, and for three days at least it was succourless. The people on the mainland knew its danger, but could not cross over to it. The Backergunge authorities were more fortunate; their boats escaped destruction, and they were able to move with all the promptitude that could be desired. The Chittagong authorities had most of their boats temporarily disabled, but, despite their own pressing needs, they managed to send succour to the devastated island of Sundip.

"Most of the trees, fruit-bearers or others, will recover, except the areca or betelnut palms. These exist in great numbers, of which very many are broken, snapped off as it were, and much of the betel crop just being gathered was destroyed, though some part was saved. The country here is well wooded, but at present it has lost all verdure and sylvan appearance; it seems to be stricken by a withering winter, and wears a drab color, with bare branches or dead leaves, or trunks contorted as if torn by some superhuman destructive agency. Many trees torn up by the roots were carried away with the flood into the great river, and there remained as sunken trees, known to sailors as 'snags,' so dangerous to navigation. They virtually barricade the passage out to sea by the western branch of the Megna, so that we were barred from approaching by water the seaface of the devastated tracts. The 'snags,' extending over an expanse of water, looked as if they had been set up by an enemy.

"The wealth lost was almost entirely agricultural—crops or cattle. To this, however, there is one notable exception, namely Dowlutkhan, a rich trading town, clean destroyed, with loss of miscellaneous property and valuable records. It had 8,000 inhabitants, one-fourth of whom perished, perhaps more. Approaching the place, we steamed for two miles through a creek, the banks of which all the way were strewn with human bodies, floated up and down by the tide.

"I give this outline of the case judging by what I saw, and by what I heard from those who were in it. The local authorities did instantly all they possibly could, and some of them managed to do a great deal. The immediate obstacle was of course the difficulty of communication. Still, day after day, sometimes hour after hour, officials, non-officials, messengers, guards, supply-boats, arrived at some point or other of the wide and scattered scenes of disaster. Since the first few hours of inevitable destruction, not a life, so far as I could learn, had been lost from any preventable cause, nor had any one been in extreme danger. Those who perished in that fatal instant of time passed suddenly beyond aid; but those who escaped then are still sustained, or are sustaining themselves sufficiently well. The disaster, big though it be, has yet happened in the midst of plenty and of rural wealth. All around the fated and wasted area there are excellent crops and abundant stores. Those who have lost their agricultural wealth have still some left, and doubtless possess considerable credit. Soon, therefore, will boats come pouring in by the numerous channels from districts teeming with water-carriage; soon will fresh cattle be swum or ferried across the rivers from the overstocked districts of Eastern Bengal; soon will the grain bazars be re-opened, and the rustic marts be filled with the surplus produce of neighbouring tracts."

ESTIMATE OF THE NUMBER OF PERSONS DROWNED IN THE CYCLONE OF 31ST OCTOBER 1876.

In the Backergunge District.

	Population.	Probable number drowned.
Dukhin Shahbazpore island	221,000	70,000
Bowful thana	118,000	15,000
Golachipa ditto	98,000	20,000
	437,000	105,000

In the Noakholly District.

	Population.	Probable number drowned.
Sundip island	87,000	40,000
Hatiya ditto	54,000	30,000
Sudharam thana	96,000	5,000
Bamni ditto	33,000	5,000
Amergaon ditto	133,000	10,000
	403,000	90,000

In the Chittagong District.

	Population.	Probable number drowned.
Meerkaserai thana	120,000	10,000
Koomeriah ditto	26,000	5,000
Chittagong ditto	76,000	5,000
	222,000	20,000
Total ...	1,062,000	215,000

AREA.

In the Backergunge District.

Dukhin Shahbazpore island ...	818	square miles.
Bowful thana	194	ditto.
Golachipa ditto	801	ditto.
Total ...	1,813	ditto.

In the Noakholly District.

Sundip island	Exact area cannot be given ; may be roughly stated at about 900 square miles.
Hatiya ditto	
Sudhuram thana	
Bamni ditto	
Amergaon ditto	

In the Chittagong District.

Meerkaserai thana	Exact area cannot be stated ; may be roughly stated at about 380 square miles.
Koomeriah ditto	
Chittagong ditto	

CHAPTER VI.

The Causes of the Backergunge Cyclone.

THE following is a very brief summary of the more important features of the origin and progress of the cyclone. On the 20th and following days there was almost uniform distribution of pressure in the Bay and Northern India. The pressure then increased to the north of the Bay, and was probably high to the south. The south-west monsoon, instead of retreating southward, continued to prevail over the sea region near the entrance to the Bay. The weather was fine and clear over the greater part of the Bay at this time, except in the south, where slight rainfall commenced. The wind directions were north and north-easterly on the west side of the Bay, and westerly to southerly on the south and east limits of the Bay. An area of diminishing pressure began to be formed on the 23rd. Constant precipitation of rain on the south-east accompanied its formation and gradually increased in amount. The area of depression extended northwards, and on the 26th and 27th the winds in the neighbourhood of the area began to show a vorticose motion and were of considerable intensity, if, as I believe, the Nancowry returns can be accepted as indicating a general cyclonic motion comparable with the wind velocity registered at that station. This area of diminishing pressure extended northwards during the two following days, whilst at the same time its vortex was also advancing slowly in the same direction. With the continuance of the cyclonic conditions the area of diminishing pressure not only expanded, but the amount of the depression at its centre increased, and on the evening of the 29th the gale of cyclonic character, which had set in some time previously and was rapidly increasing in violence, became at length a cyclone of great force. Its vortex was in latitude 14° N. and longitude 89°E. at noon of the 30th, and was then advancing slowly north at a rate of about seven miles per hour. Its velocity gradually increased, and it also acquired during its progress, very slowly at first, an eastward motion. It crossed the 20th parallel of latitude in longitude 91° 45′, and at this time was being rapidly deflected to the east. It reached the islands at the mouth of the Megna with a velocity of progression of upwards of 20 miles per hour at 3 A.M. on the 1st. The central area of calm was then from 15 to 18 miles in diameter, and was probably elliptically shaped, its greater axis being nearly at right-angles to its path. The cyclone at sea extended over a very considerable area, blowing with hurricane force and disabling vessels at a distance of 200 miles from the vortex. In its brief passage on land its dimensions were much more contracted. It advanced to the north-east from Noakholly at 4-30 A.M., but at this time its north-eastern quadrant extended *over* the Tipperah hills. They consist of a series of wave-like crests or elevations running north and south. These numerous ridges presented a formidable barrier to the rotation of the wind on the north-western quadrant. They quickly broke up the regular cyclonic motion of the wind on this side. The cyclone was completely dissolved by 10 A.M. of the 1st, the only evidence of its existence a few hours after being a slight barometric depression over the Tipperah hills, Cachar, and Assam. There was a cloudy sky, with slight rainfall in the hill districts and in Assam on this and the following day. In the centre and north of the Bay there was calm weather, a clear sky, and a smooth sea, where from twelve to twenty-four hours before the wind had been blowing with hurricane force, the rain falling in torrents, and the sea tossing about in the wildest confusion. At noon of the 1st the only evidence at sea of the passage of one of the fiercest cyclones which has visited the coast of Bengal were some twenty vessels, the majority dismasted and reduced to mere wrecks, struggling feebly towards the nearest port; whilst a few scattered sheets of water on land were all that was left to indicate that the panic-stricken, houseless, starving inhabitants of one of the richest and most populous districts of Bengal had been visited by a flood more destructive in its character than history has yet recorded.

The origin and formation of the cyclone can be explained by the same theory as I have already advanced in the case of the Vizagapatam cyclone. On the 20th there was almost uniform pressure over the Bay and the adjacent coast regions. The pressure was slightly in excess both to the north of this large area and also to the south. The two great lower atmospheric currents, which alternately blow over the Bay during the monsoon periods, were at that time neither in full possession. Each occupied a portion of the Bay. The south-west monsoon was gradually retreating southwards and blowing with diminished force, whilst the north-east trade wind, as yet very gentle in its character, had only advanced over the northern and western coasts of the Bay. It was a period of transition and of gentle winds, local rather than general in their character. The Bay thus became a closed area, so far as its atmospheric changes and motion are considered, whilst round its limits there was a near approach to a gentle cyclonic motion of the air. These conditions continued during the next eleven days. It is at all times an area of rapid evaporation. The Madras published observations, although in this one point not accurate from acknowledged defects in the construction and position of the registering instrument, show that in this month, notwithstanding that it is a cloudy period and accompanied with an average rainfall of 10″, the mean daily evaporation is ·2″. On the 20th and following days a clear sky and warm weather prevailed over the greater part of the Bay. Evaporation was probably taking place at a much more rapid rate than the above. The amount of heat absorbed by the conversion of this amount of water daily over so large an area as the Bay of Bengal is enormous. Roughly estimated, it is equal to the continuous working power of 800,000 steam-engines of 1,000 horse-power. This will give some idea of the enormous amount of energy absorbed or rendered latent in the process of conversion of water into aqueous vapour over a large area like the Bay of Bengal. There was thus a process of absorption of heat, and therefore of mechanical energy, by the atmosphere over this area, compared with which even the energy of the moving mass of air during the cyclone and of the disturbed and elevated water surface over which the cyclone passed was small. There was no horizontal outlet for this accumulating aqueous vapour. Hence, instead of passing away from the producing area, to fall as rain over Southern India and other regions to the north or south, it ascended or expanded vertically upwards. The very slight rainfall at Madras and over Southern India seems to establish conclusively the condensation of the vapour over the producing area. The rainfall at Madras, which occasionally exceeds 20″ during the month and averages 10″ was only 1·04″ for the month. The relations of aqueous vapour with respect to temperature and height are, as I have already stated, such that an equilibrated mass or atmosphere of saturated vapour of density diminishing with the height in accordance with the laws of hydrostatics or hydrodynamics is impossible. Before complete saturation can occur in the lowest strata, condensation will necessarily commence in some higher stratum, determined by the rate of decrease of temperature with the height. Hence it may be laid down as a general principle that if over any area of constant evaporation there is not for any considerable period an atmospheric current of sufficient intensity to carry off the aqueous vapour as fast as it is produced (which outflow may take place either in the lower or higher atmospheric strata), condensation must occur over the producing area, and also that the process of evaporation and subsequent condensation will be accompanied by the formation of an area of diminishing atmospheric pressure. The meteorology of the region of Calms is a striking illustration of these facts. In this narrow belt of continuous low barometer between the two trade winds the lower winds are very light and variable, whilst daily during the period of greatest evaporation there is heavy precipitation of rain.

During the continuance of these conditions which have been shown existed over the Bay from the 20th, the Bay was in a state resembling the Belt of Calms. Rapid evaporation went on, accompanied with increasing rainfall. This rainfall, as I have already pointed out, is necessarily, according to this explanation, greatest on the south side, because here the gentle wind current from the Indian Ocean on the south pours in large quantities of vapour, and thus hastens and increases the condensation on this side. The region of disturbance, with the continuance of the favourable conditions, consequently extends northwards from the southern limits of the Bay and becomes an area of diminishing pressure, just as in the Belt of Calms the continuance of the two actions of continuous evaporation and condensation over the producing region makes it a region of persistent low pressure.

Perhaps it may be urged against this, as I believe has been done by Dr. Hann, one of the greatest European authorities on all meteorological questions, that the observations at land stations within the tropics show that continuous rainfall is not accompanied by a diminution of pressure. The returns of the observations in India undoubtedly show that on land the barometer generally, but not universally, falls previous to rainfall and rises during the rainfall. But the conditions of a closed area, such as the Bay of Bengal was at this time, and the Belt of Calms is at all seasons, are so different in every respect from any land area in the tropics, except, perhaps, small islands far removed from any continent, such as the Mauritius, or even the Andamans or Nicobars, that this fact is no argument against the present theory. So little is known of the action and independent motion of the aqueous vapour in the atmosphere, and of its relations to the atmosphere of dry air, that in such a case we can only argue from the strictest analogy. The atmospheric pressure in the Belt of Calms is always lower than in the neighbouring regions of the trade winds to the north and south, and for the same reasons, whatever they may be, the southern portion of the Bay, with the prevalence of similar conditions, became at this time an area of diminishing pressure.

I might also refer to the low pressure of the great southern oceanic area as compared with the northern land area, and to other similar facts, in confirmation of my opinion. Probably, however, it will not be considered as satisfactorily established until hourly or continuous observations for a lengthened period at some small oceanic island have been carefully analyzed, and the materials for this are not at present at my disposal. A cursory examination of the observations at Sagar Island, Port Blair, and Nancowry seems to confirm my theory for oceanic closed areas. The action appears to be as follows. The evaporation over a closed area is attended by an upward expansion or vertical current, imperceptible of course to any instrument or observation. If this did not take place, the atmospheric pressure would, and must, increase. The first tendency of evaporation is undoubtedly to increase the pressure, but this, by disturbing the equilibrium, or the previous condition of motion, causes further motion, which in this case is vertical expansion. The same cause thus produces two effects opposed to each other, so far as their action on the atmospheric pressure is considered. The resultant action is a differential one, and, as in the case of the ordinary barometric tides, the balance is in favour of the expansive action; or in other words, the cause, evaporation, (just as the solar heating power in the case of the diurnal barometric tides) which first produces or tends to produce increase of pressure is actually followed by diminution of pressure. A similar argument obtains in the case of condensation and precipitation of the aqueous vapour as rain. An unknown portion of the heat given off during the process of condensation is undoubtedly radiated off into space. Some portion of it must, however, be absorbed by the surrounding air. The first tendency of this will be to increase the pressure of this portion of the atmosphere, and therefore of every other portion. This, however, will be followed by the usual expansive action, and the question then simply resolves itself into which of the two opposing actions, increase of temperature and expansion, produces the greatest effect on the pressure. In certain cases it may be the former, and that there is therefore increase of pressure with rainfall. In closed oceanic areas, where the action is continuous (like the action of the sun on the atmosphere in producing the diurnal changes of the pressure), it seems to be more consonant with analogy to assume that the resulting action will be diminution, and not increase, of pressure.

For the reasons already stated, I assume that the evaporation in the Bay of Bengal over a closed area of uniform pressure which commenced on the 20th was followed by condensation, greatest on the southern side, where the action of evaporation in saturating the atmospheric strata was supplemented by the south-westerly current from the Indian Ocean, and that both these actions produced the same effect—diminution of pressure, which commenced to the west of the Nicobars and gradually extended northwards. It is, then, easy to see how the continuance of these conditions in the Bay would produce a cyclone. The *ascendant courant* due to the action of evaporation and condensation was greatest over a small area near the Nicobars, and the centre of the area of diminishing pressure was also there. A strong indraught from the neighbouring districts followed. There, however, was no violent change or subversion of the winds in or around the Bay at the time. The atmospheric circulation was already cyclonic in its character, and the formation of the area of low pressure implies only an increase of this motion, and an advance from all sides, or closing up towards the centre. This assisted in maintaining and increasing the vertical ascent at the centre. The continuous rainfall, due partly to the indraught from all directions, also added fresh energy to the forming cyclone. Finally, from the combination of all these causes and actions and their persistence for a week or ten days, the cyclone was fully formed. It advanced at first slowly, but gradually increased in velocity in its passage over the Bay, and then, after reaching land, rapidly broke up, partly from the friction with the land, which, however, appears to be a very slight cause, but chiefly from the irregularity of the land action, tending, especially where it is hilly, to break up the large cyclonic motion into small eddies which rapidly die away, and partly from the diminution of evaporation and rainfall in its passage over the land surface. It will thus be seen that the theory advanced to explain the origin and formation of the two cyclones in the preceding pages is quite different from that put forward by Mr. Meldrum to account for the cyclones of the Indian Ocean, and adopted by Mr. Willson in his cyclone reports. As the subject is an important one, I shall refer briefly to Mr. Blanford's examination of the Calcutta cyclone of 1867, the first which he investigated with the aid of accurate and abundant observations. A brief summary is given in the Proceedings of the Royal Society, vol. XVII, for the year 1869.

1st.—Mr. Blanford states that for four or five days previous to the formation of the cyclone vortex the atmospheric pressure to the westward of the Nicobars was lower than elsewhere around the Bay, and that round the northern and western coasts the differences of pressure were very small.

2nd.—That the winds were variable in Bengal some days previous to the cyclone, but became north and north-west three days before its formation; and that the light south-easterly winds which had prevailed along the west coast of the Bay also changed to north-easterly gentle winds three or four days before the formation of the cyclone.

3rd.—The formation of the vortex was formed by the indraught of three currents—a north-east current on the west coast, a south-west current on the south, and a south-east current on the east—towards a region of low pressure produced by the action of evaporation and condensation; but was mainly and finally determined by the in-rush of a saturated westerly current towards the area of low barometer.

The first and second conditions are equivalent to uniformity of pressure at a period of transition, which I have pointed out existed prior to the two cyclones I am dealing with, and the third to the general cyclonic motion of the atmosphere round the limits of the Bay, such as must occur at the period of transition from the south-west to the north-east monsoon. The only difference that may exist between Mr. Blanford's theory and mine is in the order and relation of the causes. The primary one is evaporation and condensation in a closed area, over and round which there is almost uniformity of pressure, and the formation of the cyclone due to this is promoted and intensified by the general cyclonic circulation around its limits, and by the saturated current passing in on the south from the Indian Ocean.

I am unable as yet to decide whether all cyclones in the Bay of Bengal present the same general meteorological phenomena and admit of the same explanation.

The most difficult point in connection with the cyclones of the Bay of Bengal is to assign an adequate reason for their line of advance from the area of cyclone generation to the coast of the Bay. The majority of cyclones appear to originate in very nearly the same portion of the Bay over a small area, latitude 14° N., longitude 89° E., to the west of the Andamans, for reasons similar to those assigned for the formation of the recent cyclones in this area. But starting from the same central area of cyclone generation in the Bay, cyclones travel in very different directions, varying between W. N. W. and N. N. E. Those whose paths have been charted by the Bengal Meteorological Office during the last five or six years present one common feature. They all travel in paths very approximately straight lines in their passage over the Bay, advancing from the area of cyclone generation along the line of least resistance to their motion towards the head of the Bay. If the producing causes are not persistent for a long enough period, or are small in amount, the cyclonic disturbance dies away and never reaches the coast. But in all cases where they advance as far as the coast, they apparently never suffer deflection until they approach or reach the coast. The modifying cause in the deflection of cyclones on land is not terrestrial friction, which is probably not much greater or much more irregular than the friction of the confused and disturbed water surface over which the cyclone advances. The great modifying cause is, in the case of the cyclones of the Bay, the obstruction of mountain masses and ranges. The effect of this obstructive and disintegrating action is too strikingly shown in the case of the recent cyclones to admit of dispute. The determination of the line of least resistance to the motion of cyclones is of great importance, as it would afford a sure basis for cyclone prevision. The discussion on the causes of the recent cyclones has shown that they originated from the formation and development of an area of low pressure, commencing at the south of the Bay and extending northwards. This alone would give a reason for their advance from south to north. They have also been shown to be produced by evaporation, condensation, and rainfall over a closed sea area. Unfortunately there are no returns of rainfall over the sea area during the advance of a cyclone, and it is impossible therefore to infer the character of the distribution of the rainfall over the region of the moving cyclonic disturbance in the Bay. The distribution of the rainfall over the land area of a cyclonic disturbance is due to very different causes and affords little or no information on this important point. As far as can be judged from the general description of the rainfall in the logs of the vessels, it appears that in the outer limits of the cyclonic disturbance the rainfall is greatest (*i.e.* the rate of fall is greatest) on the southern quadrant, and that nearer the centre it is greatest on the eastern quadrant, and very near the vortex, it may be greatest on the north-eastern or even on the northern quadrant, and therefore in advance of the cyclone vortex. The action consequent on the giving out of the latent heat due to condensation is, however, on the whole greatest on the southern and eastern quadrant, and hence a second probable cause for the determination of the cyclones to some direction between west and north. The only other key to the determination of the line of least resistance to the cyclone motion appears to be the distribution of pressure around the coast. Here again, from the very brief period during which meteorological observations have been taken round the Bay, the materials for consideration are much too limited to afford data for generalization. A comparison of the distribution of pressure round the coast of the Bay at the time of the formation and first advance in the case of five cyclones shows that in four out of the five it was lowest at that part of the coast which the cyclone afterwards reached. It remains to be seen whether subsequent additional knowledge will confirm this inference, that the line of least resistance is indicated partly, if not entirely, by the distribution of pressure round the head of the Bay, and that the path of the cyclone is usually from the area of cyclone formation in some direction between west and north to that part of the coast where the pressure is relatively lowest at the time of its formation.

B. E.—Regr. No. 1280—700—24-2-77.

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PLATE III.

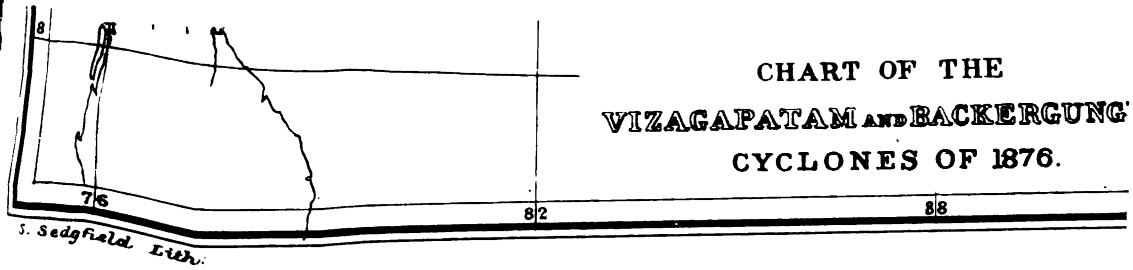

CHART OF THE
VIZAGAPATAM AND BACKERGUNGE
CYCLONES OF 1876.

S. Sedgfield Lith.

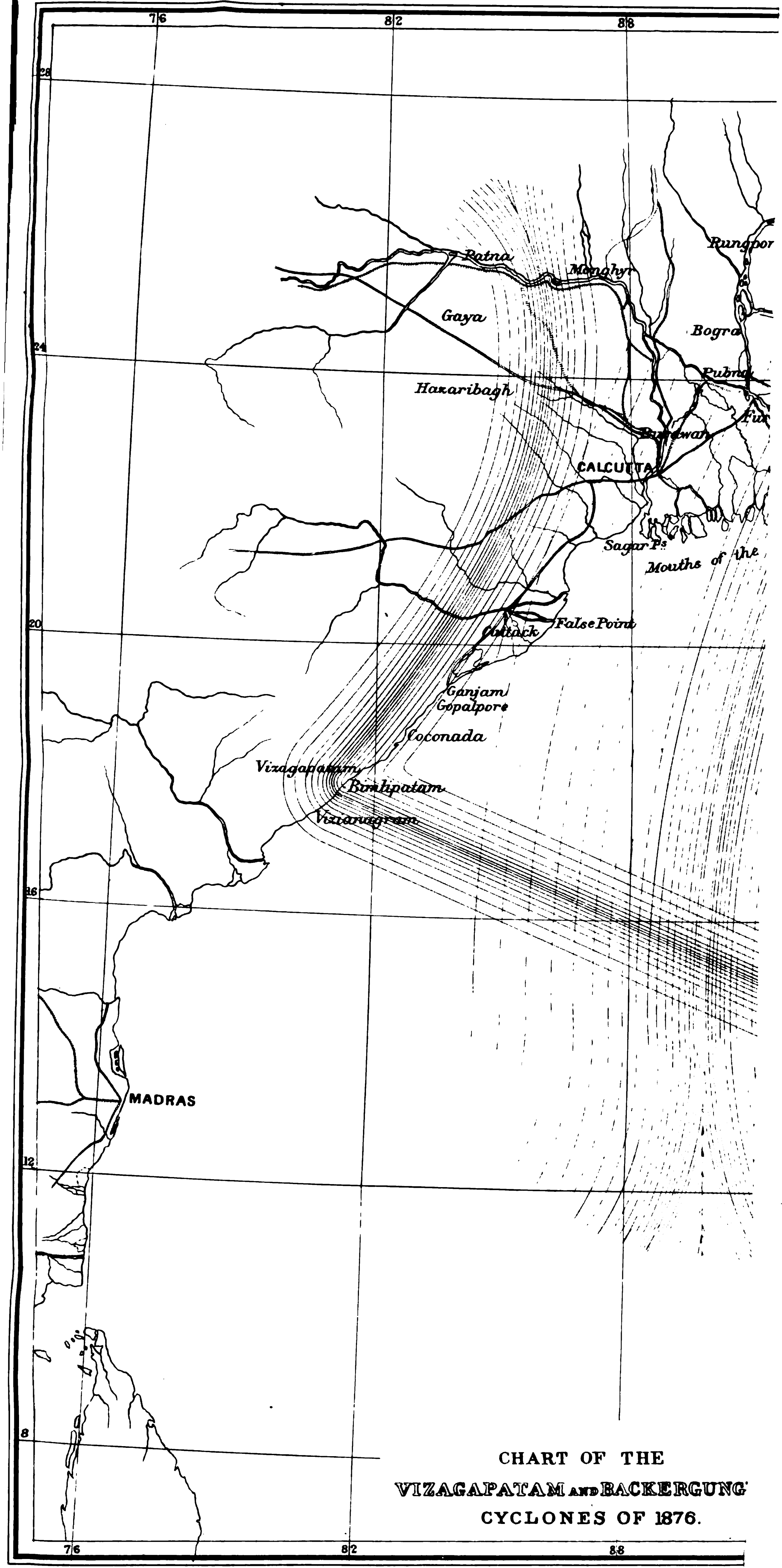

CHART OF THE
VIZAGAPATAM AND BACKERGUNG
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S. Sedgfield Lith.

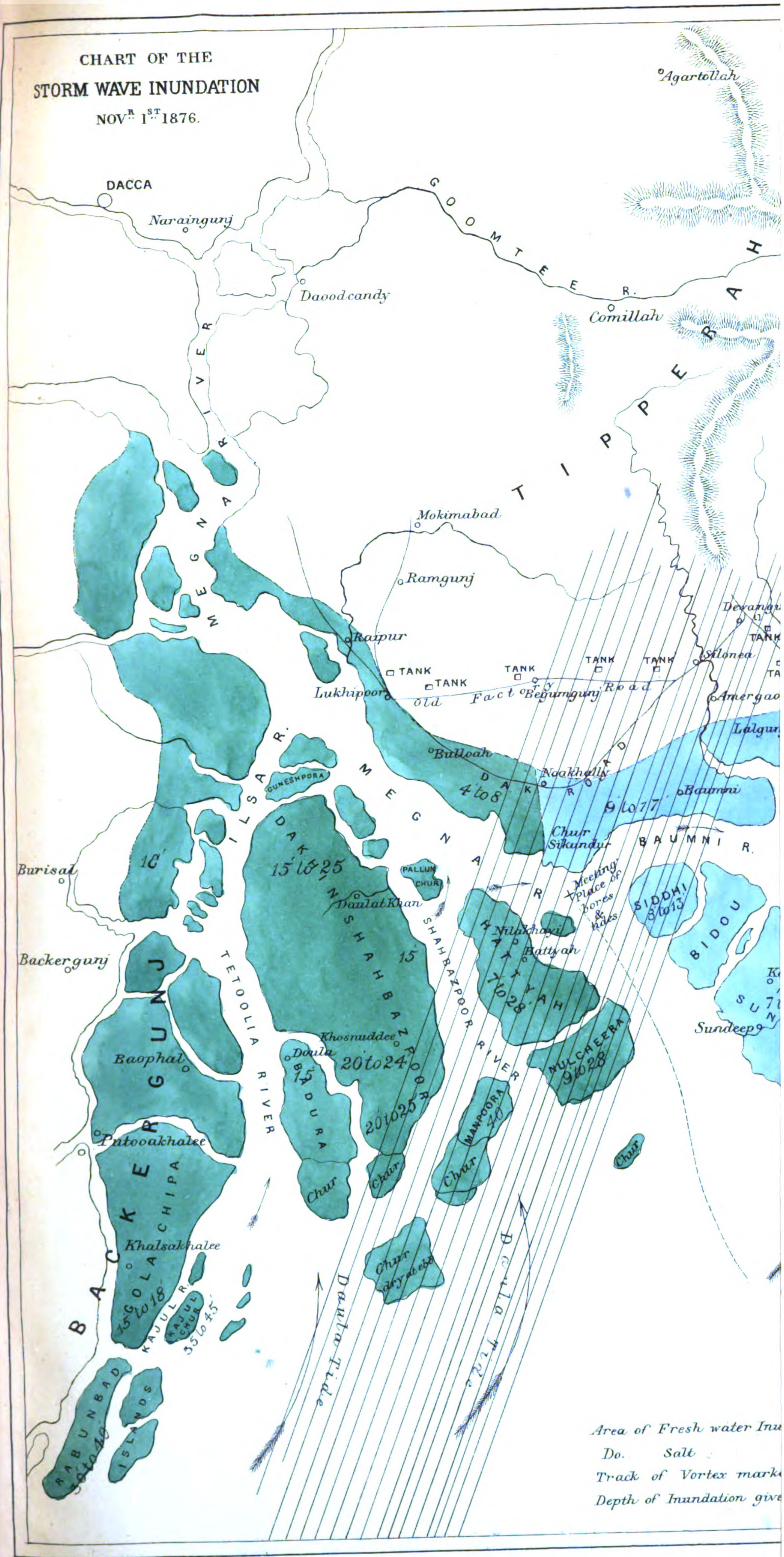

CHART OF THE
STORM WAVE INUNDATION
NOV^{R} 1ST 1876.

S. Sedgfield Lith.

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REPORT

OF THE

VIZAGAPATAM AND BACKERGUNGE CYCLONES

OF

October 1876.

BY

J. ELLIOTT, Esq., M.A.,

Meteorological Reporter to the Government of Bengal.

Calcutta:
PRINTED AT THE BENGAL SECRETARIAT PRESS.
1877.